10.0 LIMITATIONS AND STANDARDS: DATA SELECTION AND CALCULATION

This section describes the data sources, data selection, data conventions, and statistical methodology used by EPA in calculating the long-term averages, variability factors, and daily maximum limitations. The effluent limitations and standards[1] are based on long-term average effluent values and variability factors that account for variation in treatment performance within a particular treatment technology over time. As explained in the preamble to the rule, EPA is promulgating daily maximum limitations only for the Oily Wastes Subcategory. This section describes the data selection and calculations for the daily maximum limitations for total suspended solids (TSS) and oil and grease measured as *n*-hexane extractable material (O&G).

Section 10.1 gives a brief overview of data sources (a more detailed discussion is provided in Chapter 3) and describes EPA's evaluation and selection of episode data sets that are the basis of the limitations. Section 10.2 provides a more detailed discussion of the selection of the episodes and data for each pollutant. Section 10.3 presents the procedures for data aggregation. Section 10.4 provides an overview of the daily maximum limitations. Section 10.5 describes the procedures for and summary of the estimation of long-term averages, variability factors, and limitations. Section 10.6 presents an evaluation of the limitations.

10.1 <u>Overview of Data Selection</u>

To develop the long-term averages, variability factors, and limitations, EPA used concentration data from facilities with the Option 6 technology in the Oily Wastes Subcategory. These data were collected from two sources, EPA's sampling episodes and self-monitoring data.

All sampling episodes were conducted using the EPA sampling and chemical analysis protocols as described in Section 3.3. Sampling episode reports maintained in the rulemaking record present the data collected during each sampling episode.

In comments on the proposal and from other sources, EPA received compliance monitoring data from industry. These data are sometimes referred to as 'Discharge Monitoring Report' (DMR) or self-monitoring data. EPA denoted these data with a 'D' appended to the 4-digit episode identifier, the same 4-digit number used for EPA sampling data at that facility. In the statistical analyses, the self-monitoring data are treated separately from the EPA sampling data. This practice is consistent with other guidelines and is used because the data tend to be associated with different time periods and/or analytical methods than EPA sampling data.

Following the 2001 proposal and 2002 NODA, EPA received many comments on its selection of facilities and datasets used as the basis of its limitations. In response to these comments, EPA revisited its selection of facilities operating the Option 6 technology in the Oily Wastes Subcategory. As discussed in Section 10.2, for the episode datasets that were used to

[1]In the remainder of this chapter, references to 'limitations' includes 'standards.'

develop the final MP&M limitations, EPA performed a detailed review of the data and all supporting documentation accompanying the data. This was done to ensure that the selected data represent a facility's normal operating conditions and that the data accurately reflect the performance expected by the production method and treatment systems. Thus, EPA evaluated whether the data were collected while a facility was experiencing exceptional incidents (upsets).

EPA also examined the range of unit operations covered by the facilities. As part of its detailed review, EPA verified that it had selected facilities that generated wastewater that encompassed the unit operations that generated the most concentrated types of wastewater in the Oily Wastes Subcategory. (Section IV.A.3.6 of the preamble to the final rule identifies the unit operations in the Oily Wastes Subcategory.)

In evaluating the data for the rule, EPA relied on two major sources of data: sampling episode reports and data review narratives.

The sampling episode report (SER) describes the collection, analysis, and results of EPA's comprehensive sampling at a facility in support of effluent guidelines rulemakings. Each SER presents a general overview of facility operations, includes process diagrams of treatment operations, summarizes the sample fractions collected for each sample point, describes any deviations from the sampling and analysis plan, provides flow and production information, and lists the analytical data results. SERs are located in Sections 5.2 and 15.3 of the record.

The data review narratives (DRNs) present an assessment of the quality of the analytical (chemical) data, based upon a five-stage review process. The DRNs are included as an attachment to each SER. Because the data are the basis of the limitations, EPA determined that an additional evaluation of the laboratory submissions was appropriate. As a result of that evaluation, EPA confirmed that its previous determinations were appropriate for the TSS data and most oil and grease data. As explained in Section 10.2, EPA excluded some oil and grease data as a result of the evaluation. (See DCN 36500 in Section 28.5 of the record for a summary of the evaluation.)

10.2 Episode and Data Selection

This section describes the episodes selected for EPA's evaluations of the technology option for the Oily Wastes Subcategory. Table 10-1 summarizes the episode and sample point selections, and Table 10-2 identifies the unit operations for each facility.

Table 10-1

Oily Wastes Subcategory Oil/Water Separation

Episode No.	Treatment Type (specific information on treatment from LTA folders, batch vs. continuous)[1,2]	Discharger Type (indirect/ direct)	Type of Data (EPA sampling, industry sampling episode, comment data)	Influent Sampling Point	Effluent Sampling Point	Number of Effluent Data Points
4471	Process: **Eq, skim, CE, O/W,** CPT, sed Batch vs. Cont: continuous Additives: **H_2SO_4,** ferric chloride, lime, polymer Targets: unspecified Flow: unspecified	Indirect	EPA sampling	SP-1	SP-5	4
4851	Process: **API, eq, CE, skim** Batch vs. Cont: continuous Additives: **CO2, aluminum chloride** Targets: Oil and grease, metals, organics Flow: 9,900-12,000 gph during sampling	Indirect	EPA sampling	SP-11	SP-13	5
4872	Process: **CE, O/W,** oil cooking Batch vs. Cont: batch Additives: **H_2SO_4, NaOH, alum, polymer** Targets: Oil and grease Flow: design max 433,000 gal/batch × 2 batches/day; during sampling 433,133 gal/batch × 1 batch/day	Indirect	EPA sampling	SP-4	SP-5	3
4872D	Same as above	Indirect	Industry-supplied DMR data	N/A	SP-5	4
4876	Process: **CE, O/W, gravity flot,** DAF, oil cooking Batch vs. Cont: batch Additives: **polymer, alum, NaOH, H_2SO_4** Targets: Oil and grease, TSS Flow: 152,000 gpd	Indirect	EPA sampling	SP-4	SP-5	5

Table 10-1 (Continued)

Episode No.	Treatment Type (specific information on treatment from LTA folders, batch vs. continuous)[1,2]	Discharger Type (indirect/ direct)	Type of Data (EPA sampling, industry sampling episode, comment data)	Influent Sampling Point	Effluent Sampling Point	Number of Effluent Data Points
4877	Process: **Eq, CE, O/W,** oil cooking Batch vs. Cont: batch Additives: **polymer, alum, NaOH, H_2SO_4, floc** Targets: unspecified Flow: 100,000-200,000 gpd	Indirect	EPA sampling	SP-4	SP-5	5

[1]Process abbreviations:

API = API separator
CE = chemical emulsion breaking
CPT = chemical precipitation
DAF = dissolved air flotation
Eq = flow equalization
Gravity flot = gravity flotation
O/W = oil/water separation
Sed = sedimentation
Skim = oil skimmer

[2]Treatment units or additives represented by the sampling points are in bold.

Table 10-2

Unit Operations at Each Episode

Unit Operation	Description	4471	4851[a]	4872/ 4872D[b]	4876	4877
01	Abrasive Blasting	dry	dry			X
05	Alkaline Cleaning for Oil Removal	X	X	X	X	
07	Alkaline Treatment Without Cyanide					
10	Aqueous Degreasing		X	dry		X
11	Assembly/Disassembly	dry	X	dry	X	dry
12	Barrel Finishing					
13	Burnishing					
17	Corrosion Preventative Coating	X				
18	Electrical Discharge Machining					
26	Floor Cleaning		X	X	X	X
27	Grinding	X		X	X	X
28	Heat Treating	X		zero		
29	Impact Deformation		dry	X		X
30	Machining	X	X	X	X	X
32	Painting (Spray or Brush)	X	dry	zero		zero
35	Polishing			X		
36	Pressure Deformation					
39	Solvent Degreasing		X			
42	Testing (Such as Hydrostatic, Dye Penetrant, Ultrasonic, Magnetic Flux)	X	X		X	X
43	Thermal Cutting					
44	Washing of Final Products		X	X		
45	Welding	dry	dry	dry		
46OR	Wet Air Pollution Control of Organic Constituents		zero			X
65	Steam Cleaning					
71	Adhesive Bonding					
72	Calibration					
	Iron Phosphate Conversion Coating	X				

[a]4851 also performs chromium and nickel electroplating (nonoily operations) where the wastes are contract hauled and plasma arc machining (a nonoily operation) but never discharged to the water table.
[b]4872 also has manganese phosphate coating and leaking hydraulic oil from machines.

As a first step, EPA reviewed all of its data from facilities with the Option 6 treatment in the Oily Wastes Subcategory. Table 10-1 identifies all of the episodes with Oily Wastes Subcategory oil/water separation treatability data in EPA's database. EPA has data from six different sampling episodes: five are EPA sampling episodes (4471, 4851, 4872, 4876, 4877) and one is industry-supplied DMR data (4872D). For the final rule, EPA based the oil and grease limitations on the data from Episodes 4872, 4872D, and 4877 and the TSS limitation on the data from Episode 4851. The following describes EPA's evaluation of each of the six episodes and its decisions to include or exclude the data. As shown in Table 10-2, these episodes encompass a variety of unit operations included in the Oily Wastes Subcategory.

Episode 4471 was conducted at a facility that manufactured magnum tractors for the farming industry. The facility's primary water-using unit operations included alkaline cleaning, grinding, heat treating, painting, and testing of the finished product. Episode 4471 operated chemical precipitation and sedimentation following the Option 6 technology. Consequently, the facility did not need to rely on the Option 6 technology alone to meet any discharge requirements, and most likely optimized oil and grease and TSS removals following during the chemical precipitation and solids separation step. Consequently, its Option 6 technology performance had removal rates of only 31 percent for TSS and 42 percent for oil and grease during the sampling episode. In contrast, the other facilities had removal rates of over 90 percent for TSS and oil and grease using the Option 6 technology. In addition, EPA measured oil and grease using a freon method, rather than a hexane extractable method used for the other episodes. As explained in the NODA, the sampling data in Phase 1 (this includes Episode 4471) had been analyzed by EPA Method 413.2, a method utilizing freon that was unlikely to produce comparable results to methods approved under 40 CFR 136 (such as EPA Method 413.1). Thus, EPA did not use these data in determining the final daily maximum oil and grease limitation, because the facility had not optimized its Option 6 technology (because it did not need to do so) and the oil and grease data were not measured by a method comparable to those approved at 40 CFR 136.

Episode 4851 was conducted at a facility that repaired and manufactured locomotives. The facility's primary water-using unit operations included alkaline cleaning, machining, and testing of the finished product. Episode 4851 operated the Option 6 technology and was used as the basis of the final TSS daily maximum limitation because this facility had the highest concentrations of TSS in the influent (except for Episode 4876, which EPA excluded as explained below). Episode 4851's average influent TSS concentration was 833 mg/L compared to the next highest TSS influent average of 219 mg/L at Episode 4872. Although this facility, on average, had concentrated TSS influent, it also had the lowest daily value for TSS in the influent that EPA observed in its sampling of facilities in this subcategory. Because EPA was concerned that this value might not represent normal operations for a facility that normally has concentrated TSS in its influent, it excluded this one value from its calculations of the limitation. In addition, EPA excluded all of the oil and grease effluent data based upon a review of the laboratory reports. Over the five-day period for the sampling episode, EPA collected 36 oil and grease samples at the effluent sample point. One sample (36240) broke and thus was not analyzed. For 31 other samples (36232-36239, 36241-36263), when EPA performed a final review of the laboratory reports, it realized that the ongoing precision recoveries (OPR) were below the acceptable range of 79-144 percent that is specified in Method 1664. For the four remaining samples (36264-36267), EPA considered these values to be 'minimum values' because the matrix spike and its matrix sample duplicate (MS/MSD) recoveries were outside of the criteria in the method. For these reasons, EPA excluded the oil and grease data from Episode 4851.

Episodes 4872 and 4872D are from a facility that manufactured automotive parts, including axles, shafts, tubes, housings, and transmission gear sets. The facility's unit operations included machining, polishing, impact deformation (punch pressing), heat treatment (carburizing and tempering), and washing of the components. The facility also performed manganese phosphate coating and painting operations. In general, based on information obtained from episode 4872, the facility generated approximately 70 percent of the daily process wastewater from 21 aqueous parts washers, and approximately 30 percent from 14 machining operations containing a 5-percent solution of machining coolant. Less than 1 percent of the wastewater flow was generated from minor water-producing operations, including the paint booth water curtain, the manganese phosphate coating operation, heat treatment, and leaking hydraulic oil from machines (tramp oil). Because this facility also commingles wastewater generated by CFR 433 operations (i.e., manganese phosphate coating) with wastewater generated by oily waste operations, it would be subject to 433 rather than 438[2]. However, EPA determined it was appropriate to retain this facility in its Part 438 limitations calculations because the commingled wastewater from this facility largely comprises wastewater generated from oily waste operations (>99 percent). Furthermore, EPA compared the influent concentrations of the regulated parameters at this facility with those at other oily waste facilities and found them to be comparable.

During the time periods of these episodes, this facility operated the Option 6 technology to treat its wastewater. As noted in Section 10.1, EPA has treated its self-monitoring data separately from the EPA sampling data. The data for the two episodes were collected about two years apart (1997 for the sampling episode and 1999 for the self-monitoring episode). EPA expects that some changes in process, production mix, volume of production, and wastewater treatment systems were likely to have occurred during the two-year period and has used the data as if they were from two different facilities. EPA also notes that the ranges of the daily oil and grease effluent concentrations were different for the two episodes, with Episode 4872 ranging from 44.8 to 57.1 mg/L and Episode 4872D ranging from 8.6 to 23.6 mg/L.

For Episode 4872, the treatment system consisted of a large batch tank in which the facility added emulsion breaking chemicals and then allowed the oil to separate from the water. The facility then discharged the water layer (i.e., the lower layer). Upon review of the operating procedures for this facility, EPA determined that the approach used to determine when to stop the draw-down was based solely on tank level, as opposed to being based on any type of measurement. While EPA has concerns about this approach and has incorporated costs in this rule for an upgrade to remove the subjectivity, EPA determined that the Episode 4872D data

[2]See 438.2(b)

demonstrated that the system can achieve low concentrations of oil and grease when the treatment system is operated properly. For this reason, EPA has included all but one oil and grease value in calculating the limitation. EPA excluded the concentration value of 25.8 mg/L from the third grab sample (38970) on Day 1 of Episode 4872, because the MS/MSD percent recoveries were below the method criteria and the value is considered to be a minimum value. Because its field duplicate value was reported with a higher value of 65.9 mg/L and met the criteria in the data review guidelines, the field duplicate value was used in calculating the oil and grease limitation instead (i.e., sample 38970 was excluded). EPA also considered excluding the data value for the fourth grab sample (38971) on Day 1, because the MS percent recovery was below the method criteria and the relative percent difference (RPD) between the MS and its MSD also exceeded the method criteria. Despite these qualifiers, EPA decided to retain this sample because it was consistent with the value for its field duplicate (105 mg/L) which had met the method criteria.

Episode 4876 was conducted at a facility that manufactured engines for automobiles and light trucks. The primary wastewater generating operations at this facility included machining and grinding operations, which require a water-based cutting fluid. The facility also performed alkaline cleaning operations. Episode 4876 treated its wastewater using a DAF system following the Option 6 technology. When EPA reviewed these data in detail, it found that the facility appeared to be optimizing its Option 6 portion of the treatment technology for TSS removals, but not oil and grease. Because the system was not optimized for oil and grease removals (because the facility additionally used the DAF system for this purpose), EPA excluded those data in calculating the oil and grease limitation. Although the facility had a removal rate of 99 percent for TSS, EPA excluded the TSS effluent data values because EPA had collected daily grab samples at this sample point, rather than daily composite samples that EPA expects that facilities would use in complying with the final TSS daily maximum limitation[3]. As explained in Section 10.5, while it had excluded the data from its limitation calculations, EPA ultimately used these TSS data to evaluate the limitation.

Episode 4877 was conducted at a facility that manufactured and assembled automatic transmissions and chassis components. Manufacturing processes included machining, grinding, impact deformation, abrasive blasting, and aqueous degreasing of the metal components. The facility also performed painting operations; however, no wastewater was generated from painting. In general, the facility generated approximately 75 percent of its process wastewater from 60 aqueous parts washers and 20 percent from 18 machine coolant recirculation filtration systems (hydromation pits), containing a 4- to 12-percent solution of coolant used for machining and grinding operations. Miscellaneous wastewater sources such as floor washing, leaking hydraulic oil, and transmission oil from hydrostatic testing were included in the remaining 5 percent of the flow. This facility treated its wastewater using the Option 6 technology. In calculating the limitation, EPA excluded the oil and grease data from the second day because operation on that day was not representative of the normal operating conditions for

[3] This system was a batch system that discharged over the course of 24 hours. EPA expects that facilities with this type of system would conduct continuous compliance monitoring.

Option 6 technology. As documented in the sampling episode report, on that day only, the operator failed to add the proper treatment chemicals. EPA also reviewed the laboratory reports and identified qualifiers on two of the effluent samples used to calculate the oil and grease limitation, but has included both results in calculating the oil and grease limitation. These samples were the third and fourth grab samples (39564 and 39565) collected on Day 1 of the sampling episode. For both samples, the RPD between the MS and its MSD exceeded the method criteria. In addition, the MSD recovery was below the method criteria for the fourth grab sample. In conjunction with those samples, EPA had collected field duplicates. The oil and grease limitation was calculated using daily values calculated from the average of each duplicate pair. When EPA calculated the daily value with the averages of each duplicate pair (see Section 10.3), it found virtually no difference if the qualified data were included or excluded. Because their inclusion results in a minutely higher daily value for Day 1, the values for samples 39564 and 39565 were included in calculating the limitations.

10.3 Data Aggregation

In developing the limitations, EPA modeled daily data values rather than individual sample measurements. EPA's approach of aggregating multiple analytical results to obtain a single daily value is consistent with standard, conventional practice in environmental analytical work. This approach also gives one day's sampling information appropriate weight in determining effluent limitations and is consistent with requirements of NPDES regulations at 40 CFR 122 which define the daily discharge.

In some cases, EPA mathematically aggregated two or more samples to obtain a single value that could be used in other calculations. This occurred with field duplicates and grab samples collected over time to represent a single waste stream. Table 10-3 lists these values. Table 10-4 lists the influent and effluent data after these aggregations were completed and a single daily value was obtained for each day for each pollutant.

In all aggregation procedures, EPA considered the censoring type associated with the data. EPA considered measured values to be detected. In statistical terms, the censoring type for such data was 'noncensored' (NC). The Agency censored measurements reported as being less than some sample-specific detection limit (e.g., <10 mg/L) and considered them to be nondetected (ND). In the tables and data listings in this document and the rulemaking record, EPA uses the abbreviations NC and ND to indicate the censoring types. The data used as a basis for the final limitations are all NC and thus all aggregated results also are considered to be NC.

This subsection describes each of the different aggregation procedures. They are presented in the order that the aggregation was performed (i.e., field duplicates were aggregated first and grab samples second). Table 10-3 lists the effluent data before aggregation and Table 10-4 lists the daily influent and effluent values after any aggregation.

Table 10-3

Effluent Data Before Aggregation[a]

Pollutant	Episode	Sample Day	Original Sample Concentration (mg/L)	Corresponding Field Duplicate (if any) Concentration (mg/L)
Oil and Grease	4872	1	23.1	50.8
			14.4	23.3
				65.9
			108.0	105.0
		2	89.6	
			54.5	
			21.1	
			14.1	
		3	33.2	
			63.1	
			68.2	
			57.9	
	4877	1	25.0	26.0
			21.0	15.0
			33.0	20.0
			20.0	32.0
		3	12.0	
			16.0	
			10.0	
			21.0	
		4	21.0	
			11.0	
			24.0	
			29.0	
		5	13.0	
			31.0	
			8.0	
			8.0	
TSS	4851	1	54.0	26.0
		2	40.0	30.0
		3	36.0	62.0

[a]This table includes only values that were later aggregated with other values. See Table 10-4 for all daily values.

Table 10-4

Data After Aggregation (i.e., Daily Values)

Pollutant	Episode	Sample Day	Influent Daily Value (mg/L)	Effluent Daily Value (mg/L)
Oil and Grease	4872	1	696	57.050
		2	2182	44.825
		3	502	55.600
	4872D	1		12.100
		2		23.600
		3		15.200
		4		8.640
	4877	1	557	24.000
		3	997	14.750
		4	544	21.250
		5	469	15.000
TSS	4851	1	1720	40.000
		2	508	35.000
		3	373	49.000
		4	615	48.000

10.3.1 Aggregation of Field Duplicates

During its sampling episodes, EPA collected field duplicates for quality control purposes. Generally, 10 percent of the number of samples collected were duplicated. Field duplicates are two samples collected for the same sampling point at the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility. Because the analytical data from each duplicate pair characterize the same conditions at that time at a single sampling point, EPA averaged the data to obtain one value for each duplicate pair. This aggregation step for the duplicate pairs was the first step in the aggregation procedures.

10.3.2 Aggregation of Grab Samples

During its sampling episodes, EPA collected two types of samples: grab and composite. For oil and grease, EPA collected four grab samples over the course of each day of sampling during each sampling episode. To obtain one value characterizing the oil and grease levels at the sample point on a single day, EPA arithmetically averaged the measurements to obtain a single value for the day. In developing the TSS limitation, EPA used the concentration values of daily composite samples from episode 4851, and thus, this aggregation step was not necessary.

10.4 Overview of Limitations

The preceding subsections discuss the data selected as the basis for the limitations and the data aggregation procedures EPA used to obtain daily values in its calculations. This subsection provides a general overview of limitations.

The oil and grease and TSS limitations are provided as maximum daily discharge limitations. The definition provided in 40 CFR 122.2 states that the "maximum daily discharge limitation" is the "highest allowable daily discharge." Daily discharge is defined as the "discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling."

EPA did not establish monthly average limitations for oil and grease and TSS because a monthly average limitation would be based on the assumption that a facility would be required to monitor more frequently than once a month. For the rule, EPA has determined that one monthly monitoring event is sufficient; however, if permitting authorities choose to require more frequent monitoring for oil and grease and TSS, they may set monthly average limitations and standards based on their best professional judgement. (See, e.g., 40 CFR 430.24(a)(1), footnote b.)

The following three subsections describe EPA's objective for daily maximum limitations, the selection of the percentile for those limitations, and compliance with final limitations. EPA has included this discussion in Section 10.0 because these fundamental concepts are often the subject of comments on EPA's effluent guidelines regulations and in EPA's contacts and correspondence with industry.

10.4.1 Objective

In establishing daily maximum limitations, EPA's objective is to restrict the discharges on a daily basis to a level that is achievable for a facility that targets its treatment at the long-term average. EPA acknowledges that variability around the long-term average results from normal operations. This variability means that occasionally facilities may discharge at a level that is lower than or greater than the long-term average. To allow for possibly higher daily discharges, EPA has established the daily maximum limitation. A facility that discharges consistently at a level near the daily maximum limitation would not be operating its treatment system to achieve the long-term average, which is part of EPA's objective in establishing the daily maximum limitations. That is, targeting treatment to achieve the limitations may result in frequent values exceeding the limitations due to routine variability in treated effluent.

In estimating the limitations, EPA first determines an average performance level (the "option long-term average" discussed in Section 10.5) that a facility with well-designed and operated model technologies (that reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from the data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the final limitations will design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done.

Next, EPA determines an allowance for the variation in pollutant concentrations when wastewater is processed through extensive and well-designed treatment systems. This allowance incorporates all components of variability, including shipping, sampling, storage, and analytical variability. This allowance is incorporated into the limitations through the use of the variability factors that EPA calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to achieve the relevant option long-term average, EPA expects the facility will be able to comply with the limitations. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

EPA calculates the percentile used as a basis for the daily maximum limitation using the product of the long-term average and the daily variability factor. The following subsection describes EPA's rationale for selecting the 99th percentile as the basis for the daily maximum limitations.

10.4.2 Selection of Percentiles

EPA calculates limitations based upon percentiles chosen, on one hand, to be high enough to accommodate reasonably anticipated variability within control of the facility and, on the other hand, to be low enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the "best" technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the daily measurements.

The 99th percentile does not relate to, or specify, the percentage of time a discharger operating the "best available" or "best available demonstrated" level of technology will meet (or not meet) the limitations. Rather, EPA used this percentile in developing the daily maximum limitation. If a facility is designed and operated to achieve the long-term averages on a consistent basis and the facility maintains adequate control of its processes and treatment systems, the allowance for variability provided in the daily maximum limitations is sufficient for the facility to meet the requirements of the rule. EPA used 99 percent to draw a line at a definite point in the statistical distributions (100 percent is not feasible because it represents an infinitely large value), while setting the percentile at a level that would ensure that operators work hard to establish and maintain the appropriate level of control. By targeting its treatment at the long-term average, a well-operated facility should be able to comply with the limitations at all times because EPA has incorporated an appropriate allowance for variability into the limitations.

In conjunction with the statistical methods, EPA performs an engineering review to verify that the limitations are reasonable based upon the design and expected operation of the control technologies and the facility process conditions. As part of that review, EPA examines the range of performance by the facility datasets used to calculate the limitations. Some facility datasets demonstrate the best available technology. Other facility datasets may demonstrate the same technology, but not the best demonstrated design and operating conditions for that technology. For these facilities, EPA will evaluate the degree to which the facility can upgrade its design, operating, and maintenance conditions to meet the limitations. If such upgrades are not possible, then EPA will modify the limitations to reflect the lowest levels that the technologies can reasonably be expected to achieve.

10.4.3 Compliance with Limitations

EPA promulgates limitations with which facilities can comply at all times by properly operating and maintaining their processes and treatment technologies. EPA uses a percentile of a statistical distribution in developing the daily maximum limitation because statistical methods provide a logical and consistent framework for analyzing a set of effluent data and determining values from the data that form a reasonable basis for effluent limitations. EPA establishes the limitations on the basis of percentiles estimated using data from facilities with well-operated and controlled processes and treatment systems. However, because EPA uses a percentile basis, the issue of exceedances (i.e., values that exceed the limitations) or excursions is often raised in public comments on limitations. For example, comments often suggest that EPA include a provision that allows a facility to be considered in compliance with permit limitations if its discharge exceeds the daily maximum limitations one day out of 100. This issue was, in fact, raised in other rules, including EPA's final Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) rulemaking. EPA's general approach there for developing limitations based on percentiles is the same in this rule, and was upheld in Chemical Manufacturers Association v. U.S. Environmental Protection Agency, 870 F.2d 177, 230 (5th Cir. 1989). The Court determined that:

> EPA reasonably concluded that the data points exceeding the 99th and 95th percentiles represent either quality-control problems or upsets because there can be no other explanation for these isolated and extremely high discharges. If these data points result from quality-control problems, the exceedances they represent are within the control of the plant. If, however, the data points represent exceedances beyond the control of the industry, the upset defense is available.
> Id. at 230.

As that Court recognized, EPA's allowance for reasonably anticipated variability in its effluent limitations, coupled with the availability of the upset defense, reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis and/or bog down administrative and enforcement proceedings in detailed fact-finding exercises, contrary to Congressional intent. See, as an example, Rep. No.

92-414, 92d Congress, 2d Sess. 64, reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972 at 1482; Legislative History of the Clean Water Act of 1977 at 464-65.

EPA expects that facilities will comply with promulgated limitations *at all times*. If an exceedance is caused by an upset condition, the facility would have an affirmative defense to an enforcement action if the requirements of 40 CFR 122.41(n) are met. If the exceedance is caused by a design or operational deficiency, then EPA has determined that the facility's performance does not represent the appropriate level of control. For promulgated limitations and standards, EPA has determined that such exceedances can be controlled by diligent process and wastewater treatment system operational practices such as frequent inspection and repair of equipment, use of back-up systems, and operator training and performance evaluations.

EPA recognizes that, as a result of the rule, some dischargers may need to improve treatment systems, process controls, and/or treatment system operations in order to consistently meet the effluent limitations. EPA believes that this consequence is consistent with the Clean Water Act statutory framework, which requires that discharge limitations reflect the best technology.

10.5 Calculation of the Limitations

This section discusses the calculation of the daily maximum limitations for TSS and oil and grease.

First, EPA calculated the episode long-term average and daily variability factor by using the modified delta-lognormal distribution (see Appendix E). Table 10-5 lists these episode-specific values.

Table 10-5

Episode Long-Term Averages and Daily Variability Factors

Pollutant	Episode	Episode Long-Term Average (mg/L)	Episode Daily Variability Factor
Oil and grease	4872	52.6533	1.3489
	4872D	15.2101	2.4403
	4877	18.8921	1.7203
TSS	4851	43.1442	1.4312

Second, EPA calculated the option long-term average for a pollutant as the *median* of the episode-specific long-term averages for that pollutant. The median is the midpoint of the values ordered (i.e., ranked) from smallest to largest. For oil and grease, when the three episode long-term averages are ordered, this midpoint value is 18.89 mg/L from Episode 4877. For TSS, this midpoint value is the same as the episode long-term average from Episode 4851.

Third, EPA selected the option daily variability factor. For oil and grease, EPA used the self-monitoring data, Episode 4872D, as the basis of the option daily variability factor. In the proposal and NODA, when EPA used multiple episodes as the basis of a limitation, it used the *mean* of the episode daily variability factors. That practice was consistent with EPA's development of limitations for other industries. However, for this pollutant in this subcategory, EPA has determined that it is appropriate to deviate from its normal practice, because each of the self-monitoring measurements were obtained several months apart (i.e., 2/23/99, 4/29/99, 8/11/99, and 10/28/99). As explained in the NODA, EPA intended to investigate whether autocorrelation was likely to be present in the data. When data are positively autocorrelated, it means that measurements taken at specific time intervals (such as 1 day or 2 days apart) are related. To determine autocorrelation in the data, many measurements for each pollutant would be required with values for every single day over an extended period of time. Despite its requests to industry, the data were not made available to EPA for Option 6 oily wastes effluent. However, by selecting the self-monitoring data, each measured several months apart, as the basis of the option daily variability factor, EPA has avoided the possibility of autocorrelation existing in the data used as a basis of the option daily variability factor for oil and grease. For TSS, the option daily variability factor is the same as the episode daily variability factor from Episode 4851, because EPA used the data from that facility as the basis for the limitation as explained in Section 10.2. While autocorrelation might exist in the Episode 4851 data, EPA selected a facility with high concentrations of TSS in the influent as the basis of the option daily variability factor. EPA notes that no facilities with the Option 6 technology with similar high concentrations of TSS influents provided any daily measurements of TSS effluent concentrations. From the information that EPA had available to it, EPA determined that the allowance for variability provided by the Episode 4851 data was sufficient and the limitation was demonstrated to be achievable, as described later in this subsection.

Fourth, EPA calculated each *daily maximum limitation* for a pollutant using the product of the option long-term average and the option daily variability factor. EPA rounded the limitation to two significant digits. The rounding procedure rounds up values of five and above, and rounds down values of four and below. Table 10-6 provides the option long-term average, option daily variability factor, and the daily maximum limitation.

10.6 Evaluation of the Limitations

To evaluate the limitations, EPA compared the daily maximum limitations to all of the effluent data that it had received from facilities in the Oily Wastes Subcategory. In addition, EPA compared the values of the final daily maximum limitation to the values presented in the 2001 proposal and the 2002 NODA. The following subsections describe these evaluations.

Table 10-6

Option Long-Term Averages, Daily Variability Factors, and Limitations

Pollutant	Option Long-Term Average (mg/L)	Option Daily Variability Factor	Daily Maximum Limitation (mg/L)
Oil and grease	19	2.4	46
TSS	43	1.4	62

10.6.1 Comparison to Data

This section compares the daily maximum limitations to all of the data that EPA had available to it from the Oily Wastes Subcategory. In the following subsections, EPA first evaluated the TSS limitation and then the oil and grease limitation. In addition, EPA compared the data from each facility to both limitations, because it had received many comments stating that facilities would have difficulty complying with multiple limitations simultaneously. From its conclusions about the data comparisons, EPA has determined that the data do not support such assertions. As a result of the data comparisons and reviews described below, EPA has concluded that facilities that properly design and operate to achieve the option long-term average will be able to comply with the limitations.

Total Suspended Solids Limitation

For TSS, none of the daily values from Episode 4851 (i.e, the basis of the limitation) were greater than the daily maximum limitation of 62 mg/L. EPA performed this comparison to determine whether it used appropriate distributional assumptions for the data used to develop the limitations (i.e., whether the curves EPA used provide a reasonable "fit" to the actual effluent data[4] or if there was an engineering or process reason for an unusual discharge). As a result of this comparison, EPA determined that the distributional assumptions appear to be appropriate for these data. As a further evaluation of these limitations, EPA compared the individual measurements from field duplicate pairs and also found that none of the individual values were greater than the limitation.

EPA performed additional comparisons of the limitation to other EPA sampling data obtained from the Option 6 technology in the Oily Wastes Subcategory, although they were not used as a basis of the limitation. EPA compared the limitation to the TSS data values from Episode 4876 (see Section 10.2 for EPA's reasons for excluding these data from its limitation

[4]EPA believes that the fact that the Agency performs such an analysis before promulgating limitations might give the impression that EPA expects occasional exceedances of the limitations. This conclusion is *incorrect*. EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their treatment technologies.

calculations). Although this episode had more concentrated TSS influent than Episode 4851 (which was the basis for the limitation), all of its TSS effluent data values were considerably less than the daily maximum limitation. In addition, none of the individual measurements exceeded the option long-term average of 43 mg/L. For the episodes that EPA excluded from the limitations calculations because they had less concentrated influents (Episodes 4872, 4872D, and 4877), all of the daily values and individual values in each field duplicate pair were below the option long-term average, except for the data from the second sampling day during Episode 4877 when the facility did not add the proper treatment chemicals. During Episode 4471, the facility achieved levels lower than the limitation on three sampling days even though the facility had not optimized its treatment system. EPA notes that the single effluent value greater than the limitation was also greater than its corresponding influent value, and thus, the system did not demonstrate any removals of TSS on that day. (See DCNs 36000S and 36034 in Section 19.1 of the record and DCN 00573 in Section 5.2.32.1.)

EPA also compared the TSS limitation to the sampling episode and self-monitoring data obtained from three facilities (4819, 4820, and 4824) that treated oily wastes using ultrafiltration systems. The average influent concentrations at these facilities ranged from 128 mg/L to 10,100 mg/L. During the sampling episodes and their own self-monitoring, none of the facilities had average concentration values that were greater than 12 mg/L, which is substantially less than the option long-term average of 43 mg/L used in calculating the limitation. Furthermore, during EPA's sampling episodes, none of the effluent data values were greater than 17 mg/L.

EPA compared the TSS limitation to the data from Episode 7052P that operated DAF technology in addition to the Option 6 technology. The influent values ranged from 212 to 4440 mg/L. This facility demonstrated treatment performance levels below the option long-term average for each of the four days that the facility sampled.

As a further evaluation of its TSS daily maximum limitation, EPA examined TSS monitoring data provided by the questionnaire respondents that operated facilities in the Oily Wastes Subcategory, including two facilities that operated the Option 6 technology. Each facility provided the average of its TSS concentrations for one year, but not the individual measurements or the influent concentrations (because the questionnaire did not request this information). For both Option 6 facilities, the average TSS concentrations were below the daily maximum limitation as well as the long-term average. Other than these two facilities, the questionnaire respondents in the Oily Wastes Subcategory either reported that they used a different technology than Option 6 or did not provide TSS average concentrations. Except for two facilities, the reported TSS long-term averages were all less than the option long-term average. One of the two exceptions used a treatment technology that was less sophisticated than Option 6, and thus, it is to be expected that it would have a higher TSS average concentration than demonstrated by Option 6. The other exception operated a carbon adsorption and oil/water separation treatment system. Operated properly, this treatment technology is equivalent or better than the Option 6 technology. EPA did not receive sufficient information in the survey from this facility to conduct a detailed engineering analysis of their unit operations and treatment system. Using the limited information that it had, EPA compared this facility's unit operations and wastewater generating operations to similar facilities in this subcategory, and found no factors that would prevent this facility from achieving the demonstrated TSS removal of Option 6. Furthermore, this facility did not provide comments to EPA stating that it would be unable to meet the TSS limitations in the proposed rule or the NODA. EPA considers that it may be possible that the carbon adsorption system was overloaded on one or more occasions resulting in large TSS discharges that affected the overall average TSS value reported by the facility. To ensure that the facility would be capable of complying with the limitation, EPA assigned a one-time unit upgrade cost to this facility which includes contractor fees, operator training, and additional treatment controls. With this cost for additional system optimization, the site should be able to comply with the daily maximum limitation.

Oil and Grease Limitation

For oil and grease, EPA compared the daily maximum limitations to the data from Episodes 4872, 4872D, and 4877 which were used as the basis of the limitation. None of the daily values or even the individual values for grab samples from Episodes 4872D and 4877 were greater than the daily maximum limitation of 46 mg/L. For Episode 4872, EPA found some daily values (and values for individual grab samples) that were greater than the daily maximum limitation. While EPA recognizes that the data from this episode forms the technology basis of the oil and grease limitation, based upon its review of the data, EPA concluded that improvements to its system would optimize its treatment performance. Based upon this review, EPA also discussed the possibility of excluding these data from developing the daily maximum limitation because the data probably reflect less than optimal performance.[5] EPA decided to maintain a conservative approach by retaining these data in developing the limitation.[6] As a result of this comparison, EPA determined that the distributional assumptions appear to be appropriate for effluent data from the Option 6 technology.

EPA performed additional comparisons of the limitation to other EPA sampling data obtained from the Option 6 technology in the Oily Wastes Subcategory, although the data were not used as a basis of the limitation. During Episode 4876, the system still achieved levels lower than the daily maximum limitation on two of the sampling days although it was not optimized for oil and grease removals. Although EPA used most of the data from Episode 4877 in calculating the limitation, it had excluded the data for the second sampling day as explained in Section 10.2. This daily value was greater than the limitation, which is what EPA expects from a system operating without the proper treatment chemicals. EPA did not compare the Episode 4177 and 4851 data values to the limitation because any conclusions would have been hard to

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[5]A review of the treatment technology as this facility demonstrates that this facility lacks some parts of the Option 6 technology basis (i.e., skimmer).

[6]Because EPA did not include this facility in its sample for the questionnaire, it did not include costs for it in the rule. Also, as explained in Sections 11.0 and 12.0, EPA only estimated compliance costs and loadings reductions for facilities in its cost and loads model database. Had this been a costed facility, EPA would have included cost estimates for additional energy, labor and equipment for this facility to improve the operation of its current systems in order to comply with the daily maximum limitation.

interpret. As explained in Section 10.2, the data for Episode 4177 and 4851 were excluded due to concerns about the analytical method and the quality of the data. (See DCNs 36000S and 36034 in Section 19.1 of the record and DCN 00573 in Section 5.2.32.1.)

EPA also compared the oil and grease limitation to the sampling episode and self-monitoring data obtained from the three ultrafiltration facilities. Two facilities (4819 and 4820) had average effluent values that were less than the option long-term average of 19 mg/L used in calculating the limitation, and their daily effluent values during EPA's sampling episodes were all below the daily maximum limitation. These episodes had influent values ranging from 90 to 144 for Episode 4820 and 689 to 857 for Episode 4819. For the third facility (4824), EPA's sampling data had an average effluent value below the daily maximum limitation, although one daily value at 78 mg/L was greater than the limitation. During the sampling episode, the facility's oil and grease influent values ranged from 660 to 3670 mg/L. The self-monitoring data (4824D) for that facility had an average value of 47 mg/L, which is greater than the limitation. However, this facility demonstrated poor performance of the ultrafiltration system during EPA's sampling episode. It was only able to remove about half of the 5-day biochemical oxygen demand (BOD_5) and chemical oxygen demand (COD) concentrations, resulting in effluent averages of 1390 mg/L and 5450 mg/L, respectively. Thus, because this facility did not achieve typical removal rates for pollutants generally well treated by ultrafiltration, EPA has determined that its concentrations of oil and grease are abnormally high and can be corrected by improved operations.

EPA compared the oil and grease limitation to the data from the DAF facility (Episode 7052P). The effluent average concentration was below the option long-term average, with each daily concentration having a value less than the daily maximum limitation. The influent levels ranged from 212 to 1020 mg/L.

As it had for TSS, EPA examined oil and grease monitoring data provided by the questionnaire respondents that operated facilities in the Oily Wastes Subcategory, including three facilities that operated the Option 6 technology. For two of the three Option 6 facilities, the average oil and grease concentrations were below the daily maximum limitation as well as the long-term average. For the third, the average oil and grease concentration was slightly above the long-term average (21 as compared to 19 mg/L), but well below the daily maximum limitation. In the questionnaire, the facility reported that it used Method 413.1 to measure oil and grease. Because EPA used only data measured by Method 1664 in developing the TSS limitation, the slight difference between the averages might be a result of the different solvents used in the two analytical methods or just normal variability that has been incorporated into the option daily variability factor. For the nonoption 6 facilities, the reported oil and grease long-term averages were all less than the option long-term average, except for the one facility that operated a less sophisticated treatment technology, resulting in a higher oil and grease average concentration value. In developing the rule, EPA also included costs for this facility to upgrade its treatment system to comply with the daily maximum limitation.

Both Limitations

To respond to comments that stated that facilities would have difficulties complying with multiple limitations simultaneously, EPA compared the data from each facility to both limitations.

For facilities with the Option 6 technology for which EPA had daily data values for both TSS and oil and grease concentrations, only Episode 4872 had any daily values that were greater than the oil and grease daily limitation and none were greater than the TSS limitation. Thus, Episode 4872 was still able to treat its TSS and sometimes its oil and grease influent concentrations to low levels in the effluent, although, as explained above, it has not optimized its treatment system.

For facilities with the ultrafiltration technology, two had average effluent values that were below both limitations. Although the third facility had poor removals of key parameters including oil and grease, it still had adequate TSS removals and the average effluent values were less than the TSS limitation.

The facility with the DAF technology had daily concentration values below both limitations for each sampling day.

For the seven facilities that provided averages of their monitoring data in the questionnaire, only two reported effluent averages above either limitation. One facility operates a technology that is less sophisticated than Option 6, and thus, it is not surprising that its effluent is more concentrated than Option 6 levels. The other facility reports that it operates the Option 6 technology, but, while it was able to treat oil and grease to levels below detection, it had an average value greater than the TSS limitation. As explained above, EPA has incorporated costs into the rule for this facility to improve its operations.

10.6.2 Comparison to Proposed and NODA Values

EPA compared the TSS and oil and grease daily maximum limitations to the values in the 2001 proposed rule and the 2002 NODA. Table 10-7 shows the three sets of values. In the NODA, EPA requested comment on an approach that would select the higher value of the proposed and revised limitation. In general, the comments that EPA received did not address this approach, but rather focused on the data selection and achievability of the limitations. Thus, EPA has chosen to base the final limitations on its in-depth review of the episodes, as explained in Sections 10.1 and 10.2. As a result of these changes, the final oil and grease daily maximum limitation has a value that is greater than the proposed and NODA values; and the TSS daily maximum limitation has a value that is slightly less than the proposed and NODA values. EPA has determined that these are reasonable outcomes of its in-depth review of the data.

Table 10-7

Daily Maximum Limitations: Proposal, NODA, and Final Rule

Pollutant	2001 Proposal	2002 NODA	Final Rule
Oil and grease (mg/L)	27	45.9	46
TSS (mg/L)	63	63.0	62

11.0 COSTS OF TECHNOLOGY BASES FOR REGULATIONS

This section presents EPA's estimates of costs for the MP&M industry to comply with the technology options considered and described in Section 9.0. EPA estimated the compliance costs for each technology option in order to determine potential economic impacts on the industry. EPA also weighed these costs against the effluent reduction benefits resulting from each technology option. This section includes cost estimates for options and subcategorization schemes that EPA selected for promulgation and for those that EPA ultimately rejected. Section 12.0 presents Agency estimates of corresponding annual pollutant loadings and removals. The Agency is reporting estimates of potential economic impacts associated with the total estimated annualized costs of the regulation separately, in the Economic, Environmental, and Benefit Analysis of the Final Metal Products & Machinery Rule (EEBA).

Section 11.1 summarizes the costs associated with each stage of the regulation development process. The remainder of this section discusses the following information:

- Section 11.2: Selection and development of cost model inputs;
- Section 11.3: The methodology for estimating costs, including an overview of the cost model;
- Section 11.4: The specific methodology and assumptions used to estimate costs for the Notice of Data Availability (NODA) and for analyses after the NODA;
- Section 11.5: Design and cost elements for pollution prevention and end-of-pipe technologies;
- Section 11.6: Examples of how sites were allocated costs, from start to finish; and
- Section 11.7: References used in this section.

Tables are presented in the text and figures are located at the end of this section.

11.1 Summary of Costs

This subsection summarizes EPA's final capital, operating and maintenance (O&M), and annualized cost estimates for each final regulatory option. Table 11-1 summarizes the capital and O&M costs and Table 11-2 summarizes the annualized costs. These tables also present costs for each

Table 11-1

Incremental Capital and O&M Costs

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs ($2001)			Final Rule Costs ($2001)			Technology Basis for Final Rule?
			Number of Sites	Capital Costs	O&M Costs	Number of Sites	Capital Costs	O&M Costs	
General Metals	Direct	Option 2	1,521	215,372,532	406,618,406	228	16,302,446	10,582,427	No
	Indirect	Option 2, 1 MGY cutoff	2,354	545,616,505	718,480,881	NA			No
		Upgrade Option	NA			429	65,548,547	36,159,912	No
		50% Local Limits	NA			628	95,760,054	40,732,283	No
Metal Finishing Job Shops	Direct	Option 2	24	6,136,725	3,952,333	NA			No
	Indirect	Option 2	1,270	252,665,620	167,585,291	NA			No
		Upgrade Option	NA			314	51,694,660	11,409,399	No
Non-Chromium Anodizing	Direct	Option 2 (model site)	35	21,726,209	35,625,488	19	2,473,423	6,584,137	No
	Indirect	Not Proposed	NA						No
Printed Wiring Board	Direct	Option 2	4	1,117,553	222,423	NA			No
	Indirect	Option 2	840	178,724,756	176,775,257	NA			No
		Upgrade Option	NA			354	51,588,250	17,942,002	
Steel Forming and Finishing	Direct	Option 2	41	12,089,100	28,744,590	Not Covered by MP&M			No
	Indirect	Option 2	112	19,399,831	22,760,945	Not Covered by MP&M			No
Oily Wastes	Direct	Option 6	2,749	14,578,563	34,841,549	2,382	6,505,602	13,110,283	Yes
	Indirect	Option 6, 2 MGY cutoff	288	16,338,598	94,408,489	NA			No

Table 11-1 (Continued)

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs ($2001)			Final Rule Costs ($2001)			Technology Basis for Final Rule?
			Number of Sites	Capital Costs	O&M Costs	Number of Sites	Capital Costs	O&M Costs	
Railroad Line Maintenance	Direct	Option 10	31	5,941,283	3	NA			No
		Option 6	NA			9	See Footnote A		No
	Indirect	Not Proposed	NA						No
Shipbuilding Dry Dock	Direct	Option 10	6	601,172	3,152,880	6	See Footnote A		No
	Indirect	Not Proposed	NA						No

Source: EPA Costs & Loadings Model.
Note: Cost estimates presented in this table will not equal those presented in the EEBA. These estimates do not include costs for facilities that are projected to close in the baseline.
NA - Not applicable.
Footnote A - Based on DMR data received both from the model facilities and in comments, EPA considered the final removals to be negligible. Therefore, the Agency did not calculate exact final costs.

Table 11-2

Incremental Annualized Costs

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs ($2001)		Final Rule Costs ($2001)		Option Promulgated?
			Number of Sites	Annualized Costs	Number of Sites	Annualized Costs	
General Metals	Direct	Option 2	1,521	431,321,635	228	12,452,318	No
	Indirect	Option 2, 1 MGY cutoff	2,354	781,063,094	NA		No
		Upgrade Option	NA		429	43,678,331	No
		50% Local Limits	NA		628	51,715,961	No
Metal Finishing Job Shops	Direct	Option 2	24	4,656,215	NA		No
	Indirect	Option 2	1,270	196,566,038	NA		No
		Upgrade Option	NA		314	17,338,777	No
Non-Chromium Anodizing	Direct	Option 2 (model site)	35	38,117,484	19	6,867,838	No
	Indirect	Not Proposed	NA				No
Printed Wiring Board	Direct	Option 2	4	350,606	NA		No
	Indirect	Option 2	840	197,274,986	NA		No
		Upgrade Option	NA		354	23,859,174	No
Steel Forming and Finishing	Direct	Option 2	41	30,131,210	Not Covered by MP&M		No
	Indirect	Option 2	112	24,986,106	Not Covered by MP&M		No
Oily Wastes	Direct	Option 6	2,749	36,513,710	2,382	13,856,475	Yes
	Indirect	Option 6, 2 MGY cutoff	288	96,282,526	NA		No
Railroad Line Maintenance	Direct	Option 10	31	681,469	NA		No
		Option 6	NA		9	See Footnote A	No
	Indirect	Not Proposed	NA				No

Table 11-2 (Continued)

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs ($2001)		Final Rule Costs ($2001)		Option Promulgated?
			Number of Sites	Annualized Costs	Number of Sites	Annualized Costs	
Shipbuilding Dry Dock	Direct	Option 10	6	3,221,834	6	See Footnote A	No
	Indirect	Not Proposed	NA				No

Source: EPA Costs & Loadings Model.
Note: Cost estimates presented in this table will not equal those presented in the EEBA. These estimates do not include costs for facilities that are projected to close in the baseline.
NA - Not applicable.
Footnote A - Based on DMR data received both from the model facilities and in comments, EPA considered the final removals to be negligible. Therefore, the Agency did not calculate exact final costs.

option considered following proposal of the rule and compares EPA's final cost estimates to those presented in the NODA. Cost estimates presented in this section differ from those presented in the EEBA because of additional EEBA annual costs (e.g., taxes and amortization). In addition, the EEBA cost estimates exclude facilities that EPA projected will close in the baseline (i.e., facilities already financially stressed without the additional compliance costs associated with this rule). The remainder of this section discusses the methodology EPA used to calculate its final cost estimates. For a discussion of the costing methodology EPA used at NODA, see Section 16 of the rulemaking record.

11.2 <u>Development of Cost Model Inputs</u>

This subsection describes the key inputs to the cost model: model sites, wastewater discharge parameters, pollutant concentrations, and technology in place. This section also discusses the data sources used to determine these parameters. Section 11.3 describes how the cost model uses the input data.

11.2.1 Model Site Development

The Agency used a model-site approach to estimate costs for the water-discharging sites in the MP&M Point Source Category. A model site is an operating MP&M survey site whose regulatory status, and unit operation and treatment information were used as input to the cost model. EPA selected a site-by-site model approach to estimate compliance costs, as opposed to a more generalized approach, to better characterize the variability of both process water and wastewater discharges in the MP&M industry. EPA selected 915 model sites from the 1,563 sites returning surveys. EPA excluded sites if:

- The site's operations did not fall within the scope of this rulemaking;
- The site did not discharge wastewater (treated or untreated) to either a surface water or publicly owned treatment works (POTW); or
- The site did not supply sufficient technical data to estimate compliance costs and pollutant loading reductions associated with the technology options.

Each of the 915 facilities is considered a "model" facility for two reasons. First, because only a portion of the MP&M universe was surveyed, each facility represents a larger number of similar facilities in the overall industry population, as determined by its statistical survey weight. Section 3.0 discusses the development of survey weights. The surveyed sites represent an estimated industry population of more than 44,000 sites that discharge either directly to surface waters or indirectly through a POTW. Second, because only a portion of the MP&M universe was sampled, EPA used its sampling data to model an aggregated influent to treatment concentration for each survey site based on the survey subcategory and the unit operations the site performs. Section 12.0 discusses the use of unit operation sampling data. Additionally, the

Agency made engineering assumptions based on national information from standard engineering costing publications, equipment vendors, and industry-wide data. Thus, for any given model site, the estimated costs and loads may deviate from those that the site would actually incur. However, EPA considers the compliance costs to be accurate when evaluated on an industry-wide, aggregate basis.

11.2.2 Wastewater Streams and Flow Rates

EPA used wastewater discharge parameters (e.g., production rates, flow, and operation schedule) to calculate wastewater generation and discharge rates. The cost model uses these flow rates to estimate the capacity of treatment units needed for each wastewater stream. Using information from survey responses, follow-up letters, and phone calls, EPA first classified each process wastewater stream by the type of unit operation generating the wastewater (e.g., machining, electroplating, acid treatment). For each unit operation, EPA then determined production rate, operating schedule, wastewater discharge flow rate, and discharge destination. Some sites provided all the information needed for each wastewater stream, but others did not. EPA determined the wastewater discharge parameters as described below:

- **Production rate.** In survey responses, sites reported production rates in surface area processed, mass of metal removed, or air flow rate, depending on the unit operation. Production expressed in terms of surface area represented surface finishing or cleaning operations; mass of metal removed represented metal removal operations such as machining and grinding; and air flow rate represented air pollution control operations. For blank responses, EPA statistically imputed production rates using other data provided in the site's survey or by using data for similar unit operations reported in other MP&M surveys. The general methodology as well as specific production calculations can be found in DCN 36200 in Section 28.2 of the rulemaking record.

- **Operating schedule.** EPA used survey responses to represent the operating rate (hours per day (hpd) and days per year (dpy)) of each unit operation. For blank responses, EPA used the following:

    - The maximum hpd and dpy reported by the site for other unit operations, if reported by the site, or

    - The survey response for wastewater treatment system operating schedule, if the site provided a wastewater treatment operation schedule, or

    - 8 hpd and 260 dpy. This estimate represents the median work schedule for MP&M sites.

- **Wastewater discharge flow rate.** For each process wastewater stream, most sites reported the total wastewater discharge flow rate from the unit operation and associated rinses. For sites that reported performing a unit operation but did not report a discharge flow rate, EPA statistically imputed wastewater flow rates using other data provided in the site's survey or by using data for similar unit operations reported in other MP&M surveys. The general methodology as well as specific calculations for sites' wastewater flow rates can be found in DCN 36200, in Section 28.2 of the rulemaking record.

- **Discharge destination.** EPA used survey responses to determine the discharge destination of each unit operation (surface water, POTW, no discharge, contract haul, or other alternatives) and the level of treatment prior to discharge (none, pollution prevention, chemical precipitation, sedimentation, etc.). In many cases, a site had multiple discharge destinations. EPA assumed no costs would be incurred at baseline for wastewater streams not discharged to POTWs or surface waters (i.e., those contracted for off-site disposal, deep-well injected, discharged to septic systems, reused on site, or otherwise not discharged (recycled, evaporated, etc.)). For sites that did not report a discharge destination for some or all operations, EPA used other MP&M survey information (e.g., types of discharge permits, discharge destination of other unit operations, process flow diagrams) to determine the stream discharge destination. For details on determination of site discharge destination, see Section 24.6.1 of the rulemaking record, DCNs 17881, 17825, and 17826.

EPA then used the completed wastewater discharge information to create the first of three cost model input databases, Model Site Profile 1 (MSP1). Table 11-3 summarizes the information contain in MSP1.

Table 11-3

Information Contained in MSP1

Field Name	Description
SiteID	Random Site Identification Number assigned by EPA.
UPNum	Unit operation number as reported in the survey. (See Section 4.0 for a list of unit operations performed at MP&M facilities.)
UPExt	Unit operation extension. Each unique unit operation was given a new extension (e.g., electroless nickel plating might be UP20-1 and electroless copper plating might be UP20-2).
UPRinse	Unit operation rinse indicator. "0" designates a unit operation, "R" designates a unit operation rinse.

Table 11-3 (Continued)

Field Name	Description
StreamID	A consolidation of the fields UPNum, UPRinse, and UPExt used by the cost model (UPNum+UPRinse"-"UPExt).
SiteDest	Overall site wastewater discharge destination as determined by the survey.
Weights	Industry Weighting Factor; this number indicates how many sites the survey represents on a national basis (see Section 3.0 for more information).
FLOW	Unit operation discharge flow in gallons per hour.
PROD	Unit operation production in PNP per hour.
PNP	Production-normalizing parameter; standard cubic feet per minute, square feet, or pounds of metal removed depending on the unit operation.
PNF	Production-normalized flow, equivalent to FLOW/PROD.
HPD	Hours per day that the unit operation operates.
DPY	Days per year that the unit operation operates.
TANKVOL	Unit operation tank volume in gallons.
NUMUNITS	Number of individual units represented by the unit operation (e.g., 30 machines performing the same operation, operating the same hours and days, and using the same process chemicals would be represented by one unit operation in MSP1 but would have a numunits of 30).
BASEMET	Base metal of the part on which the operation is being performed.
METAPPL	Metal being applied by the unit operation (where appropriate).
DEST	Stream discharge destination as determined by the detailed unit operation information.
RinseCode	Rinse water code used to determine the level of pollution prevention currently in place at the site. Refer to Section 5.3.2.2 of the rulemaking record, DCN 15773, for specific code definitions.
Equipment Code	Equipment code used to determine the amount of equipment currently in place at the site. Refer to pollution prevention documentation for specific code definitions.
MCTIP	Indication of whether the stream has machine coolant treatment in place (yes/no).
IXTIP	Indication of whether the stream has ion exchange treatment in place (yes/no).
PCTIP	Indication of whether the stream has paint curtain treatment in place (yes/no).

11.2.3 Wastewater Pollutant Concentrations

EPA developed pollutant concentrations for the model sites' wastewater streams. The cost model tracks two concentrations for each wastewater stream: the baseline pollutant concentration and the post-compliance pollutant concentration. The baseline pollutant concentration represents what the site currently discharges. The post-compliance pollutant concentration represents what the site would discharge after installing the regulatory option technology.

EPA assigned each wastewater stream a baseline pollutant concentration for each pollutant of concern (POC) in the second input database named MSP2. The cost model used this information to calculate both costs and pollutant loadings. The remainder of this section describes how the cost model used pollutant concentration data to estimate costs. Section 12.0 discusses how the cost model used these data to estimate pollutant loadings. Table 11-4 summarizes the information contained in MSP2.

Table 11-4

Information Contained in MSP2

Field Name	Description
SiteID	Random Site Identification Number assigned by EPA.
StreamID	A consolidation of the fields UPNum, UPRinse, and UPExt used by the cost model (UPNum+UPRinse"-"UPExt).
PollCode	Pollutant identification code (e.g., CU, NA, TS). Refer to analytical data documentation (Section 5.3.2.2 of the rulemaking record, DCN 15773) for specific code definitions.
CHEM_NAM	Chemical Name (e.g., copper, sodium, total suspended solids). Refer to analytical data documentation for specific code definitions.
PollConc	Pollutant concentration as defined through analytical data (mg/L). Refer to Section 12.0 for concentration development information.

11.2.4 Technology in Place

The term "technology in place" refers to those treatment technologies installed and operating at a model site. EPA recognizes the importance of identifying which wastewater streams were already being treated. For example, sites with technology in place that met or exceeded the option technology would incur no additional costs, and sites with some technology in place would need only parts of the option technology. Sites with technology in place that met or exceeded the option technology but did not treat all of the required streams with this technology would incur costs to increase capacity, if required. Therefore, EPA identified technology in place from survey responses, which documented the technology in place at the time of the survey response. EPA's surveys cover two base years: 1989 and 1996. Because EPA has two base years for this industry, where EPA received updated TIP information up to the later base year of 1996, EPA incorporated this updated information in its analyses. The cost model used these data to determine what components of the option technology a site would need, as in Example 11-1 at the end of this section.

The regulatory options include two types of wastewater treatment: (1) in-process pollution prevention and source reduction (pollution prevention) and (2) end of pipe. EPA determined the technologies in place for all unit operations, both pollution prevention and end of pipe; however, some sites did not provide information on the pollution prevention technology in place. The following paragraphs describe in detail how EPA determined pollution prevention technologies in place for these sites.

Determination of Pollution Prevention Technology In Place

Although both the 1989 and 1996 MP&M Detailed Surveys requested detailed information on end-of-pipe treatment in place, only the 1996 MP&M Detailed Survey requested information about a site's in-process pollution prevention technologies. Where available, EPA determined pollution prevention technology in place based on survey responses (e.g., for all 1996 survey respondents). For other model sites, the Agency determined pollution prevention technology in place based on other survey information. For example, EPA examined the model site's production-normalized flow rate (PNF). The PNF is the volume of wastewater generated per unit of production, as described in the following equation:

$$PNF = \frac{FLOW}{PROD} \qquad \textbf{(11-1)}$$

where:

PNF = Production-normalized flow, gallons per ton;
FLOW = Annual wastewater discharge, gallons per year; and
PROD = Annual production, tons per year.

Generally, the less wastewater generated per volume of production, the better the pollution prevention technology in place. Therefore, if the site PNF was below the median PNF calculated for the industry for that pollution prevention technology, then EPA assumed the site had the pollution prevention technology in place. For example, if a 1989 survey site reported a machining wastewater stream with a PNF below the median PNF for centrifugation and pasteurization of machining coolants, then the Agency assumed that the model site had a machining coolant regeneration/recycling system in place. The median PNFs estimated for each technology are detailed in Section 24.6.1 of the rulemaking record, DCN 17885.

Determination of Rinse Scheme Technology In Place

EPA used a similar method to determine which sites had efficient rinse schemes. For unit operations without the option rinse technology in place, EPA estimated costs to install and operate a two-stage countercurrent cascade rinse. EPA used the following parameters in designing rinse technology upgrades:

- **Rinse technology in place.** EPA determined which of the following rinse technologies sites had in place:

  - Two overflow rinse tanks,
  - One overflow rinse tank,
  - One stagnant tank followed by one overflow tank,
  - One spray rinse, or
  - Two-stage countercurrent cascade rinsing.

For sites that did not provide information on their rinse scheme, EPA classified their rinse type based on the PNF for the industry. First EPA calculated site-specific PNFs for all rinses with data. Next, the Agency calculated the median industry PNFs for each rinse type. Finally, EPA assigned each unknown stream a rinse type corresponding to the stream's PNF.

For more information on the median PNF calculations and the PNFs associated with each rinse type, see Section 24.6.1 of the rulemaking record, DCN 17885.

- **Tank volume.** The cost model uses unit operation tank volume as a design parameter for countercurrent cascade rinsing, but the Agency did not request this information in the surveys. EPA estimated additional tank volume needed based on the annual discharge flow rate.

EPA then estimated what new pollution prevention equipment a site would need to meet the regulatory option. Sites with countercurrent cascade rinsing in place would not require rinse upgrades. Sites with parts of countercurrent cascade rinsing, such as tanks but not enough piping, were allocated costs for the piping and pumps needed. Additional information on the rinse flow reduction methodology can be found in Section 24.6.1 of the rulemaking record, DCN 17885. Section 11.3.3 also discusses flow reduction methodology.

Determination of End-of-Pipe Technologies in Place

EPA reviewed survey data for each model site to assess the end-of-pipe technologies in place (e.g., chemical reduction of chromium, sludge pressure filtration). EPA found some technologies in place that were not part of the regulatory options but achieve removals equivalent to the option technology. For example, the Agency considered vacuum filtration equivalent to pressure filtration for sludge dewatering. EPA also assumed that some sedimentation and oil treatment systems qualified as treatment in place for multiple options. For example, if a site had microfiltration in place for solids removal, EPA considered that equivalent treatment for either microfiltration or clarification. If a site had a clarifier in place, EPA considered it equivalent for clarification, but not for microfiltration. Table 11-5 lists the technologies that EPA considered equivalent to the option technologies. EPA also found technologies that it did not consider equivalent to option technologies. For example, EPA did not consider oil/water separation equivalent to dissolved air flotation in the advanced technology options. Conversely, the Agency considered dissolved air flotation to achieve equivalent or better pollutant removals than oil/water separation. EPA assumed that sites specifying only chemical precipitation also had a clarifier and vice versa. In addition, the Agency assumed sites with treatment systems in place have the associated chemical feed systems. Assumptions regarding treatment technologies in place at each model site are discussed in detail in Section 6.5, DCN 15799, and Section 24.6.1, DCN 17888, of the rulemaking record.

Table 11-5

Treatment Technologies Considered Equivalent to the Option Technologies

Technology Specified by Option	Technologies Considered Equivalent or Better to the Option Technologies
Chelated metals treatment	Chelated metals treatment
Chemical emulsion breaking and gravity oil/water separation	Chemical emulsion breaking and gravity oil/water separation Chemical emulsion breaking and gravity flotation Dissolved air flotation General oil water separation[a] Ultrafiltration
Chemical precipitation and sedimentation	Chemical precipitation Sites without chemical precipitation and (1) with ion exchange were assumed to have technology equivalent to chemical precipitation and clarification (2) with dissolved air flotation assumed to have technology equivalent to given chemical precipitation and clarification[a] (3) with pH adjustment and sludge dewatering/filter press were assumed to have technology equivalent to chemical precipitation, clarification, and sludge dewatering/filter press[a]
Chromium reduction	Chromium reduction
Clarification	Clarification Microfiltration Dissolved air flotation (where no other chemical precipitation is present)[a]
Cyanide reduction	Cyanide reduction Ion exchange
Dissolved air flotation	Dissolved air flotation Ultrafiltration
Filter press	Filter press Vacuum filtration
Microfiltration for solids removal	Microfiltration
Multimedia filtration	Multimedia filtration
Sludge dewatering	Sludge dewatering Gravity thickener Sludge settling tank
Ultrafiltration for oil removal	Ultrafiltration for oil removal

[a]These technologies are considered equivalent only for the purpose of defining treatment in place, not as a proven method of meeting the final limits.

EPA also used survey data to determine the capacity of the end-of-pipe technologies in place at the model sites for the following parameters:

- **Operating schedule.** EPA used the operating schedule (hpd and dpy) for each treatment unit supplied by sites. For blank responses, EPA determined the schedule using the following:
  - The maximum hpd and dpy reported for other treatment units,
  - The maximum hpd and dpy reported for the unit operations, if all hpd and dpy responses for all treatment units were blank,
  - The maximum hpd and dpy reported by the site for other unit operations associated with other treatment units, or
  - 8 hpd and 260 dpy, if all hpd and dpy survey responses were blank for unit operations and treatment units.
- **Wastewater streams treated.** For blank responses, EPA determined which wastewater streams were treated by the technology in place using survey process flow diagrams or survey responses regarding the destination of individual process wastewater streams. If this information was not provided, EPA used the cost model logic described in Section 11.3 to help assign streams to technologies (e.g., EPA assumed that cyanide-bearing streams were treated through cyanide destruction, if the site currently had it in place).

EPA used the operating schedule and wastewater stream flows treated by the technology to define the capacity needed for each technology using the following equation:

$$V \times SA = \frac{Q}{HLR} \tag{11-2}$$

where:

V	=	Volume of tank needed, gallons;
SA	=	Surface area of tank, gallons per foot;
Q	=	Discharge flow, gallon per minute; and
HLR	=	Hydraulic loading rate. EPA set the HLR to 1,000 gallons per square foot per day.

The Agency determined design capacity from one of two flows: the survey-provided design capacity flow (when available) or the model design capacity flow as derived from the 122 percent of baseline flow. The methodology for calculating the model flow is discussed in detail in Section 11.3.4. EPA also accounted for those sites that may need to increase wastewater treatment capacity as a result of the process changes associated with some of EPA's technology options. Section 11.3.4 presents how EPA accounted for baseline end-of-pipe technologies with insufficient capacity. Also, more details on capacity calculations are in Section 6.7, DCN 15902, and Section 24.6.1, DCN 17903, of the rulemaking record. All stream-by-stream treatment-in-place information was then incorporated into the final input database MSP3. Table 11-6 summarizes the information contained in MSP3.

Table 11-6

Information Contained in MSP3

Field Name	Description
SiteID	Sited Identification Number assigned by EPA.
UPNum	Unit operation number as reported in the survey.
UPPrefix	Identifier that indicates if the UPNum refers to a unit operation, in-process pollution prevention operation, or treatment unit. EPA used this field to aid in the creation of MSP3 (e.g., UP or TU).
UPExt	Unit operation extension. Each unit operation was given a new extension (e.g., electroless nickel plating might be UP20-1 and electroless copper plating might be UP20-2).
OldExt	Field used in the creation of MSP1 and MSP3.
UPSuffix	Unit operation rinse indicator. "0" designates a unit operation, "R" designates a unit operation rinse.
StreamID	A consolidation of the fields UPNum, UPRinse, and UPExt used by the cost model (UPNum+UPRinse"-"UPExt).
MODULE	Indicates which treatment units the site currently has in place.
HPD	Hours per day that the treatment unit operates.
DPY	Days per year that the treatment unit operates.
SITEDCF	The design capacity flow reported by the site in survey data (gph).
DCF	The design capacity flow populated during cost model operation. This is equivalent to the larger of the following: the sitedcf or a minimum dcf calculated in the cost model. Refer to cost model documentation (Section 24.6.1, DCN 17890) for complete DCF creation information (gph).

11.2.4.1 Baseline Model Runs

The baseline run simulated the current treatment practices at each model site. The cost model uses baseline costs to determine the incremental costs for each regulatory option. EPA first performed a baseline run of the cost model to determine the following parameters:

- Estimated baseline O&M costs incurred by sites in 2001 dollars;
- Estimated baseline non-water quality impacts such as electricity usage, sludge generation, and waste oil generation;

- Estimated baseline pollutant effluent concentrations (see Section 12.0); and

- Capacity flow rate of each wastewater treatment technology in place.

11.2.4.2 Post-Compliance Model Runs

Following the baseline model run, EPA then ran a post-compliance cost model run for each regulatory option. Each cost model run calculated the following values:

- Incremental capital investment costs incurred by sites in 2001 dollars;

- O&M costs incurred by sites in 2001 dollars;

- Non-water quality impacts such as electricity usage, sludge operation, and waste oil generation; and

- Pollutant loadings discharged after installation of the option technology (see Section 12.0).

EPA calculated incremental O&M costs as the difference between baseline and post-compliance, using the following equation:

$$\text{O\&M Costs}_{\text{Incremental}} = \text{O\&M Costs}_{\text{Treated}} - \text{O\&M Costs}_{\text{Baseline}} \qquad \textbf{(11-3)}$$

EPA used the same methodology to calculate incremental values for non-water quality impacts and pollutant loadings.

11.2.4.3 New Source Model Runs

EPA also ran new source cost model runs for the General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Oily Wastes Subcategories. These runs estimated the costs a new source would incur in meeting the new source standards considered for Part 438. Model sites were used to calculate total construction and operating costs associated with a brand new treatment system consisting of the appropriate option technology. Each cost model run calculated the following values:

- Total, rather than incremental, capital investment costs incurred by sites in 2001;

- Total, rather than incremental, O&M costs incurred by sites in 2001 dollars;

- Total, rather than incremental, monitoring costs incurred by sites in 2001 dollars;
- Non-water quality impacts such as electricity usage, sludge operation, and waste oil generation; and
- Pollutant loadings discharged after installation of the option technology (see Section 12.0).

The model estimated total costs for new sources to meet the considered 438 limitations as follows:

Subcategory[a]	Discharge Destination	Number of MP&M Sites	Capital Costs ($2001)	Annual Costs ($2001)	Annualized Costs ($2001)
General Metals	Direct	794	116,844,985	310,919,560	324,321,680
	Indirect	10,307	1,851,638,823	2,268,371,865	2,480,754,838
Metal Finishing Job Shops	Direct	12	5,546,098	2,612,444	3,248,581
	Indirect	1,542	372,340,073	276,027,559	318,734,965
Non-Chromium Anodizing	Direct	None Identified			
	Indirect	122	76,369,114	112,525,473	121,285,010
Printed Wiring Board	Direct	8	3,128,633	2,697,791	3,056,645
	Indirect	818	230,533,415	255,151,103	281,593,286
Oily Wastes	Direct	2,585	79,678,368	101,830,335	110,969,444
	Indirect	26,608	575,295,361	1,629,178,524	1,695,164,902

[a]EPA did not perform new source cost model runs for the Railroad Line Maintenance or Shipbuilding Dry Dock Subcategories because, as discussed in the preamble to the final rule, EPA determined that national regulation of discharges in these subcategories is unwarranted at this time.

Note that for metal-bearing subcategories, EPA then costed new sources to operate two separate chemical precipitation and solids separation steps in series. This was done to address concerns raised by commentors that single-stage precipitation and solids separation may not achieve sufficient removals for wastewaters that contain significant concentrations of a wide variety of metals that precipitate at disparate pH ranges. To calculate the addition of a second stage of treatment, EPA doubled the original treatment costs.

11.3 General Methodology for Estimating Costs of Treatment Technologies

This subsection discusses the methodology for estimating costs, including the components of cost (Section 11.3.1), the sources and standardization of cost data (Section 11.3.2), the cost model (Section 11.3.3), and assumptions made during the costing effort (Section 11.3.4).

11.3.1 Components of Cost

The components of the capital and annual costs and the terminology used in developing these costs are presented below.

Capital Investment Costs

The capital investment costs consist of two major components: direct capital costs and indirect capital costs. The direct capital costs include:

- Purchased equipment cost, including ancillary equipment (e.g., piping, valves, controllers);
- Delivery cost (based on the equipment weight and a shipping distance of 500 miles); and
- Installation/construction cost (including labor and site work).

EPA derived the direct components of the total capital cost separately for each treatment unit or pollution prevention technology. When possible, EPA obtained costs for various sizes of preassembled, skid-mounted treatment units from equipment vendors. If costs for these units were not available, EPA obtained catalog prices for individual system components (e.g., pumps, tanks, feed systems) and summed these prices to estimate the cost for the treatment unit.

Indirect capital costs consist of secondary containment, engineering, contingency, and contractor fees. These costs together with the direct capital costs form the total capital investment. EPA estimates the indirect costs as percentages of the total direct capital cost, as shown in Table 11-7.

Annual Costs

Annual costs include the following:

- **Raw material costs** - Chemicals and other materials used in the treatment processes (e.g., sodium hydroxide, sulfuric acid, sodium hypochlorite);
- **Operating labor and material costs** - The labor and materials directly associated with operation of the process equipment;
- **Maintenance labor and material costs** - The labor and materials required for repair and routine maintenance of the equipment;

- **Energy costs** - Calculated based on total energy requirements (in kiloWatt hours (kW-hrs)); and

- **Monitoring and analytical costs** - The periodic sampling and analysis of wastewater effluent samples to ensure that discharge limitations are being met.

Table 11-7

Components of Total Capital Investment

Item Number	Item	Cost	Source
1	Equipment capital costs including required accessories	Total equipment cost	MP&M cost model capital cost curves
2	Site work, including demolition, concrete repair, and build out	3% of total equipment cost	Attachment 1 (DCN 16027, Section 6.7.1)
3	Shipping cost, based on weight of equipment and 500-mile shipping radius	Technology-specific cost, see individual cost module	Attachment 2 (DCN 16027, Section 6.7.1)
4	Installation, based on estimated number of hours for each technology at a rate of $29.67/hour	Technology-specific cost, see individual cost module	MP&M cost modules
5	Direct capital cost	Sum of items 1 through 4	
6	Engineering/administrative and legal costs	10% of item 5	Attachment 1 (DCN 16027, Section 6.7.1)
7	Secondary containment/land costs	10% of item 5	Attachment 3 (DCN 16027, Section 6.7.1)
8	Total plant cost	Sum of items 5 through 7	
9	Contingency	15% of item 8	Attachment 1 (DCN 16027, Section 6.7.1)
10	Contractor's fee	5% of item 8	Attachment 1 (DCN 16027, Section 6.7.1)
11	Total capital investment	Sum of items 8 through 10	

11.3.1.1 Total Annualized Costs

EPA calculated total annualized costs (TAC) from the capital and annual costs. The Agency assumed a 7-percent discount rate over an estimated 15-year equipment life, using the following equation:

$$\text{Annualized Cost} = (\text{Incremental Capital Cost}) \times 0.1147 + (\text{Incremental Annual Cost}) \qquad \mathbf{(11\text{-}4)}$$

11.3.2 Sources and Standardization of Cost Data

EPA obtained capital and annual cost data for the technologies that constitute EPA's technology options (see Section 9.0) from equipment vendors, literature, and MP&M sites. The Agency used specific data from the 1989 and 1996 MP&M Detailed Surveys whenever possible; however, the required types of data were often either not collected or not supplied by the sites. The major sources of capital cost data were equipment vendors, while the literature sources provided most of the annual cost information.

- **Capital Equipment.** EPA obtained information on capital equipment from vendors in 1998; specific cost estimates for technologies are included in Section 6.7.1 of the rulemaking record.

- **Chemicals.** EPA used the Chemical Marketing Reporter from December 1997 to obtain chemical prices (2). A list is in Section 6.7.1 of the rulemaking record, DCN 15890.

- **Water and Sewer Costs.** EPA based water and sewer use prices on average data collected through an EPA Internet search of various public utilities located throughout the United States for years ranging from 1996 to 1999. The average water and sewer use charges were $2.03 per 1,000 gallons and $2.25 per 1,000 gallons, respectively. The results of the Internet search can be found in Section 6.7.1 of the rulemaking record, DCN 15890.

- **Energy.** EPA used average electricity prices from the U.S. Department of Energy's Energy Information Administration. The average electrical cost to industrial users from 1994 to 1996 was $0.047 per kW-hr (see Section 6.7.1 of the rulemaking record, DCN 15890).

- **Labor.** EPA used a labor rate of $29.67 per hour to convert the labor requirements of each technology into annual costs. The Agency obtained the base labor rate from the Monthly Labor Review, which is published by the U.S. Bureau of Labor Statistics of the U.S. Department of Labor. Excluding the maximum and minimum values, EPA used the largest remaining monthly value for 1997 for production labor in the fabricated metals industry, $12.90 per hour, as a conservative estimate. The Agency added 15 percent of the base labor rate for supervision and 100 percent for overhead to obtain the labor rate of $29.67 per hour (3). See Section 6.7.1 of the rulemaking record, DCN 15890.

- **Off-Site Treatment/Disposal.** EPA estimated average costs of contracting for off-site waste treatment/disposal using data from the 1996 MP&M Detailed and Screener Surveys, as discussed in Section 11.4.4.

The Agency estimated costs to dispose of RCRA hazardous metal hydroxide sludge from Pollution Prevention and Control Technology for Plating Operations (4). Table 11-8 presents the treatment/disposal costs for various waste types. See Section 6.7.1 of the rulemaking record, DCN 16023.

- **Monitoring Costs.** MP&M effluent monitoring costs were developed based on sampling frequency, the cost per analysis, and the labor to collect the samples. Monitoring costs vary depending on the current regulatory status of the facility. The following subsections describe the MP&M monitoring frequency requirements and the estimated incremental monitoring costs for each MP&M subcategory.

Table 11-8

Costs for Contracted Off-Site Treatment/Disposal of Various Waste Types

Waste Type	Cost ($/gallon)
RCRA hazardous nonhazardous paint sludge	3.70
RCRA hazardous metal hydroxide sludge (3)	1.95
RCRA nonhazardous oil	0.86
Solvent (paint and paint stripping waste)	2.85
Oily wastewater	1.33
General metal-bearing wastewater	2.00
Cyanide-bearing wastewater	5.64
Hexavalent chromium-bearing wastewater	3.51
Chelated metal-bearing wastewater	1.40

Source: 1996 MP&M Detailed and Screener Surveys.

EPA standardized capital and annual cost data to 1996 dollars (the most current year for which EPA collected survey data). Final industry cost estimate numbers are then converted to 2001 dollars using the Engineering News-Record Construction Cost Index. For cases where EPA's information is not representative of 1996, EPA adjusted the cost estimates using RS Means Building Construction Historical Costs as shown in Table 11-9 (see Section 6.7.1 of the rulemaking record, DCN 15890).

Table 11-9

RS Means Building Construction Historical Cost Indexes

Year	Index
1989	92.1
1990	94.3
1991	96.8
1992	99.4
1993	101.7
1994	104.4
1995	107.6
1996	110.2
1997	112.8
1998	114.4

Source: Historical Cost Indexes, RS Means Building Construction Cost Data, 56th Annual Edition, 1998, page 594 (1).

Monitoring Frequency for Metal-Bearing Subcategories

When developing costs for the Part 438 effluent limits considered for the metal-bearing subcategories, EPA considered a monitoring frequency of once per week for regulated pollutants. EPA calculated the costs for the Part 438 limitations assuming the monitoring frequencies listed in Table 11-10. See Section 24.6.1 of the rulemaking record, DCN 17911.

Sampling and Analysis Costs

EPA developed sampling labor and equipment requirements based on its experience gained during the MP&M sampling episodes. The Agency determined laboratory analysis costs for each regulated pollutant by contacting PEL Laboratories in Tampa, Florida. Using the monitoring frequency, labor hours to collect samples, the loaded labor rate ($29.67/hour), and the cost per analysis, EPA estimated the annual monitoring costs for various facilities.

Table 11-10

Monitoring Frequencies Used to Develop Part 438 Limitations Considered for Metal-Bearing Subcategories

Regulated Pollutant	Sample Type	Samples/week	Samples/month	Samples/year
Cadmium	Composite	1	4	48
Chromium	Composite	1	4	48
Copper	Composite	1	4	48
Lead	Composite	1	4	48
Nickel	Composite	1	4	48
Silver	Composite	1	4	48
Tin	Composite	1	4	48
Zinc	Composite	1	4	48
Cyanide (total)	Composite	1	4	48
Oil and grease (as HEM)	Grab	4	12	192
pH	Composite	1	4	48
Total Toxic Organic (TTO) parameter[a]	Grab	0	1	12

[a]Sum of volatile organics, semivolatile organics, pesticides and PCBs.

Incremental monitoring costs for metal-bearing MP&M facilities depended on their current regulatory status. Incremental costs for facilities currently regulated by Part 433 or assumed to be meeting Part 433 (e.g., direct-discharging facilities in the General Metals Subcategory) to comply with the limits considered for existing and new source Part 438 resulted from:

- Adding tin to the list of regulated pollutants;

- Lowering the effluent limit for lead, which requires analysis by graphite furnace atomic adsorption ($28/sample) rather than inductively coupled plasma ($20/sample); and

- Increasing the number of samples for oil and grease from one to four during each sampling event.

Incremental sampling labor costs result from the need to collect four oil and grease samples rather than one during the facility's daily processing period. The annual incremental monitoring cost for a Part 433 facility to comply with the limits considered for Part 438 were approximately $22,000 for the metal-bearing subcategories (see Section 24.6.1 of the rulemaking record, DCN 17911). These incremental monitoring costs are conservative (e.g., some Part 433 facilities may be currently collecting four oil and grease grab samples per monitoring day and some that generate oily waste may have either implemented an Organics Management Plan or are already collecting 12 TTO samples per year).

Costs for new source facilities (not including existing facilities that become new source facilities) result from the purchase or rental of sampling equipment, sampling labor, and laboratory analysis. The monitoring and analytical cost for these new source facilities to comply with the considered effluent limits was $41,000 for the metal-bearing subcategories (see Section 24.6.1 of the rulemaking record, DCN 17911).

Monitoring Frequency for Oil-Bearing Subcategories

EPA evaluated monitoring frequency separately for the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories due to the high percentage of survey- and comment-supplied DMR sampling data in each of these subcategories. One hundred percent of the direct discharging railroad line maintenance facilities supplied sampling data and some associated sampling frequency information. Ninety-two percent of the direct discharging oily wastes facilities, with treatment in place, supplied sampling data and some associated sampling frequency information. Fifty percent of the shipbuilding dry dock facilities supplied sampling data and some associated sampling frequency information.

Direct discharging MP&M facilities in the Oily Wastes Subcategory will be required to monitor their discharges for total suspended solids (TSS) and oil and grease. Based on the supplied information, for the Part 438 limitations, EPA calculated incremental monitoring costs assuming all direct discharging facilities are currently analyzing at least one TSS and oil and grease sample per month. Therefore, incremental monitoring costs for these facilities is zero[1]. Monitoring frequencies are determined by the permit writer and must be a minimum of once per year. The monitoring frequency specified in MP&M National Pollutant Discharge Elimination System (NPDES) permits will vary depending upon the size of the facility, potential impacts on receiving waters, compliance history, and other factors, including monitoring policies or regulations required by permit authorities. EPA encourages permit writers to require all facilities subject to the Part 438 limitations to collect a minimum of one TSS and oil and grease sample per month. Facilities may monitor more frequently than specified in their permits; however, the results must be reported in accordance with Part 122.41(1)(4)(ii) for direct dischargers.

[1]Based on the information in its database, EPA concludes most facilities currently collect one sample per month. During EPA sampling events, EPA collected four grab samples at each sampling point each day. These samples were analyzed individually with the results composited mathematically to obtain a single daily concentration for each pollutant at each sampling point. While the final limitations are based on these composited values, the analytical method allows a facility to composite multiple grab samples prior to analysis. Therefore, analytical costs should remain constant for these facilities even if permit writers require them to collect a composite, rather than grab sample.

11.3.3 Development of the Cost Model

The cost model consists of the following programming components:

- Model shell;
- Model drivers;
- Data storage files; and
- Technology modules.

The model shell includes a program that creates various menus and user interfaces that accepts user inputs and passes them to the appropriate memory storage areas. The model drivers are programs that access technology modules in the proper order for each option and process model-generated data. Data storage files are databases that contain cost model input and output data. Information typically stored in data storage files includes:

- Flow, production, and operating data associated with each wastewater stream;

- Pollutant concentrations associated with each wastewater stream; and

- Site-specific data regarding existing technologies in place (discussed in Section 11.2.4).

Technology modules are programs that calculate costs and pollutant loadings for a particular pollution control technology. EPA developed cost modules for the pollution prevention and end-of-pipe technologies included in the regulatory options for the MP&M industry.

The technology drivers perform the following functions for each technology costed for a site (if applicable):

- Locate and open necessary input data files;
- Store input data entered by the user;
- Open and run the appropriate technology modules; and
- Calculate and track model outputs.

Table 11-11 lists the treatment technology modules that are used in the cost model. Section 11.5 discusses the technology modules.

In the context of the MP&M cost program, “model” refers to the overall computer program and “module” refers to a computer subroutine that generates costs and pollutant loadings for a specific in-process or end-of-pipe technology or practice (e.g., chemical precipitation and sedimentation, contract hauling). EPA adapted some modules from previous

EPA rulemaking efforts for the metals industry and developed others specifically for this rulemaking effort.

Table 11-11

Wastewater Treatment Technologies and Source Reduction and Recycling Practices for Which EPA Developed Cost Modules

In-Process Technologies and Practices	End-Of-Pipe Technologies and Practices
Countercurrent cascade rinsing Centrifugation and pasteurization of machining coolants	Chemical reduction of hexavalent chromium Cyanide destruction Chemical reduction of chelated metals Chemical emulsion breaking and gravity oil/water separation Chemical emulsion breaking and dissolved air flotation Gravity oil emulsion breaking (baseline only, see Section 11.3.4) Ultrafiltration for oil removal Contract hauling of solvent degreasing wastewaters Chemical precipitation Inclined clarification for solids removal Microfiltration for solids removal Sludge thickening Sludge pressure filtration Multimedia filter (baseline only, see Section 11.3.4)

Source: MP&M Surveys, MP&M Site Visits, Technical Literature.

11.3.3.1 Modeling Technology Options

The model drivers access technology modules in the proper order for each technology option (e.g., in-process flow control and pollution prevention followed by end-of-pipe treatment). The drivers' logic dictates which unit operations feed which treatment technologies. EPA assumed wastewater destination based on unit operation wastewater characteristics: cyanide-bearing wastewater feeds cyanide destruction and flowing rinses feed countercurrent cascade rinsing. Table 11-12 lists the assigned unit operations feeding each treatment technology. Note that a unit operation can feed more than one treatment technology or in-process pollution prevention technology. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by chemical precipitation, inclined clarification or microfiltration for solids removal, sludge thickening, and sludge pressure filtration, except for wastewater from the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories, and except for solvent-bearing wastewater, for which EPA estimated costs for off-site disposal.

Table 11-12

List of Unit Operations Feeding Each Treatment Unit or In-Process Technology

Treatment Technology/Pollution Prevention Technology	Unit Operations Feeding Technology[a]
Countercurrent cascade rinsing	Acid treatment with chromium rinse
	Acid treatment without chromium rinse
	Alkaline cleaning for oil removal rinse
	Alkaline treatment with cyanide rinse
	Alkaline treatment without cyanide rinse
	Anodizing with chromium rinse
	Anodizing without chromium rinse
	Aqueous degreasing rinse
	Barrel finishing rinse
	Chemical conversion coating without chromium rinse
	Chemical milling rinse
	Chromate conversion coating rinse
	Corrosion preventive coating rinse
	Electrochemical machining rinse
	Electroless plating rinse
	Electrolytic cleaning rinse
	Electroplating with chromium rinse
	Electroplating with cyanide rinse
	Electroplating without chromium or cyanide rinse
	Electropolishing rinse
	Heat treating rinse
	Salt bath descaling rinse
	Solvent degreasing rinse
	Stripping (paint) rinse
	Stripping (metallic coating) rinse
	Testing rinse
	Washing finished products rinse
	Carbon black deposition rinse

Table 11-12 (Continued)

Treatment Technology/Pollution Prevention Technology	Unit Operations Feeding Technology[a]
Countercurrent cascade rinsing (cont.)	Galvanizing/hot dip coating rinse
	Mechanical plating rinse
	Laundering rinse
	Cyanide rinsing
	Ultrasonic machining rinse
	Phosphor deposition rinse
Centrifiguration and pasteurization of machining coolant	Multiple unit operation rinse
	Grinding
	Machining
Centrifugation of painting water curtains	Painting - spray or brush
	Painting - immersion
Chemical emulsion breaking and oil/water separation OR Dissolved air flotation OR Ultrafiltration system for oil removal	Alkaline cleaning for oil removal and rinse
	Alkaline treatment without cyanide
	Aqueous degreasing
	Assembly/disassembly
	Electrical discharge machining rinse
	Electrolytic cleaning
	Electroplating without chromium or cyanide
	Floor cleaning and rinse
	Grinding
	Grinding rinse
	Heat treating
	Impact deformation and rinse
	Machining and rinse
	Painting - spray or brush
	Painting - immersion
	Pressure deformation
	Steam cleaning rinse
	Stripping (paint)

Table 11-12 (Continued)

Treatment Technology/Pollution Prevention Technology	Unit Operations Feeding Technology[a]
Chemical emulsion breaking and oil/water separation OR Dissolved air flotation OR Ultrafiltration system for oil removal	Stripping (metallic coating) rinse
	Testing
	Thermal cutting rinse
	Washing finished products and rinse
	Bilge water
	Mechanical plating
	Photo image developing
	Photo imaging
	Steam cleaning
	Vacuum impregnation
	Laundering
	Calibration
	Centrifugation and pasteurization of machining coolant
Chemical reduction of hexavalent chromium	Acid treatment with chromium and rinse
	Anodizing with chromium and rinse
	Chromate conversion coating and rinse
	Electroplating with chromium and rinse
	Stripping (paint)
	Wet air pollution control - chromium
	Chromium drag-out reduction and rinse
Chemical reduction of chelated metals	Electroless plating and rinse
Cyanide destruction	Alkaline treatment with cyanide and rinse
	Electroplating with cyanide and rinse
	Cyanide rinsing and rinse
	Cyanide drag-out destruction and rinse
	Wet air pollution control - cyanide
Solvent hauling	Solvent degreasing

[a]A unit operation can feed more than one treatment technology or in-process pollution prevention technology. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by chemical precipitation, inclined clarification or microfiltration for solids removal, sludge thickening, and sludge pressure filtration, except for wastewater from the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories, and except for solvent-bearing wastewater, for which EPA estimated costs for off-site disposal.

11.3.3.2 Modeling Flow Reduction

Figure 11-2 shows the logic used by the cost model to apply the in-process flow reduction to each model site. EPA estimated flow reductions resulting from applying in-process pollution prevention technologies to any streams that did not already have the technology in place (see Section 11.2.4). The estimated flow reductions are as follows:

- EPA estimated a 20- to 80-percent flow reduction achieved by converting the current rinse scheme in place to countercurrent cascade rinsing (DCN 15993, Section 6.7.1 of the rulemaking record and Section 15.0 of this document and 1996 survey data). The flow reduction applied depends on the rinse scheme currently in place. An 80-percent flow reduction corresponds to converting a high-flow two-stage continuous overflow rinse to a two-stage countercurrent cascade rinse. A 20-percent flow reduction corresponds to converting a stagnant rinse followed by a continuous overflow rinse to a two-stage countercurrent cascade rinse. EPA computed the flow reductions based on information collected in the MP&M surveys.

- EPA assumed that centrifugation and pasteurization of machining coolants reduced coolant use by 80 percent (see Section 6.7.1 of the rulemaking record, DCN 15802). EPA assumed that a site combined all wastewater from machining operations prior to centrifugation and pasteurization of machining coolants.

- EPA assumed that centrifugation of painting water curtains allowed 100 percent reuse of the treated wastewater in the painting booth, or zero discharge (sludge removed from the centrifuge is contract hauled). EPA assumed a site combined wastewater from painting streams prior to paint curtain centrifugation.

11.3.3.3 Modeling End-of-Pipe Treatment for Metal Bearing Subcategories

The logic used by the model drivers to access end-of-pipe technologies varies depending on whether the subcategory is primarily metal bearing or oil bearing. Figure 11-3 presents the logic used by the cost model to apply the end-of-pipe treatment technologies and practices for the following metal-bearing wastewater subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing. In developing costs, EPA assumed sites would segregate wastewater streams according to pollutant characteristics (chromium, cyanide, chelated metals, oil, and solvent). Segregating wastewater streams provides the most efficient and effective treatment of wastes. Because treating solvent-bearing waste streams may require Treatment Storage and Disposal (TS&D) permitting, EPA assumed model sites would contract for off-site disposal of solvent-bearing wastewater streams, while the other segregated wastewater streams would receive preliminary treatment. The cost model assumed that effluent from preliminary treatment technologies would be combined with other wastewater streams that did not require preliminary treatment prior to estimating the cost of treating the combined wastewater. Model drivers also direct treatment unit order; for example, sludge from chemical precipitation goes to thickening and pressure filtration prior to off-site disposal. EPA assumed wastewater from chemical precipitation and sedimentation systems would be discharged to either a surface water or POTW according to the model site's current discharge destination (see Section 11.3.4 for general discharge status assumptions for sites with multiple discharge destinations).

11.3.3.4 Modeling End-of-Pipe Treatment for Oily Subcategories

The model drivers access modules to simulate oily wastewater treatment. Figure 11-4 presents the logic used to apply the end-of-pipe treatment technologies and pollution prevention practices for the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories. Each of these subcategories generates wastewater that primarily contains oily constituents and low concentrations of dissolved metals; therefore, EPA did not include chemical precipitation and sedimentation following oil treatment for these subcategories.

11.3.3.5 Model Output

The model drivers track output including the following site-specific information for each technology:

- Total direct capital costs;
- Total direct annual costs;
- Electricity used and associated cost;
- Sludge generation and associated disposal costs;
- Waste oil generation and associated disposal costs;
- Water-use reduction and associated cost credit;
- Chemical usage reduction and associated cost credit;
- Effluent flow rate; and
- Effluent pollutant concentrations.

Section 11.6 discusses calculation specifics for each technology module.

11.3.4 General Assumptions Made During the Costing Effort

This subsection presents general assumptions that EPA included in the cost model. Section 11.4 discusses specific assumptions made for NODA and post-NODA analyses. Section 11.6 discusses technology-specific assumptions.

Baseline Year Determination

EPA estimated costs for the MP&M industry for the base years 1989 and 1996 (the years in which survey data were collected). The Agency included sites (or operations) that operated during the 1989 and 1996 calendar years in the cost and loadings analyses if the site operated at least one day during the respective calendar year. If a site (or operation) shut down before 1996, it was removed from the costing and pollutant loadings analyses. If a site (or operation) commenced after 1989 (Phase I) or 1996 (Phase II), EPA did not include the site (or operation) in the costing or pollutant loadings analyses. See Section 3.1 for additional information regarding EPA's use of 1996 as the base year for its analyses for this rule. Furthermore, if a site did not discharge wastewater to surface water or a POTW in 1989 (Phase I) or 1996 (Phase II) (e.g., was a zero or alternative discharger), then EPA excluded the site from the costing and pollutant loadings analysis.

If EPA has information that a Phase I site installed or significantly altered its wastewater treatment systems before 1996, EPA used the updated data. Also, if a site changed its discharge status before 1996, EPA used the updated discharge status in its analyses. Some sites provided information during the comment period that corrected information submitted with their survey. For example, a Phase 1 site may have completed its survey as having no treatment for oily discharges but submitted information during comment that it had installed treatment prior to 1996. In these cases, EPA revised the input data to reflect the corrected site information.

Capacity of End-of-Pipe Technology in Place

For sites with technology in place, EPA assessed the design capacity flow for each treatment unit using the derived design capacity flow from the larger of two values: the site's reported survey design capacity flow or the flow calculated by the cost model baseline run, as described in Section 11.2.4, assuming the baseline flow is 78 percent of the design capacity flow. MP&M survey data indicate, on average, that flow entering the treatment units is 78 percent of the design flow reported by the survey respondent. Therefore, rather than assuming that the site is operating at 100 percent of the design capacity when survey information is unavailable, EPA assumed the site is operating at 78 percent of the design capacity. Therefore, flows can increase by as much as 22 percent over the current flow before either additional treatment capacity or contract hauling is required (see Section 6.7 of the rulemaking record, DCN 15902). The Agency determined the need for greater capacity using the following logic:

- If the technology was not in place at the model site, then EPA assigned capital costs to the site for a treatment unit of sufficient capacity.

- If the technology was in place at the model site with sufficient capacity to treat all of the applicable MP&M wastewater, then EPA assigned no additional capital costs.

- If the site had a technology in place equivalent to the option technology but with insufficient capacity to treat all the applicable MP&M wastewater, then EPA assumed the site would operate the existing system at full capacity. EPA assigned costs for the option technology train to run in parallel with the existing treatment to handle the additional flow.

Contracting for Off-Site Treatment/Disposal in Lieu of Treatment

EPA assessed the cost to contract for off-site treatment/disposal of wastewater compared to on-site treatment. Because many MP&M sites have flow rates less than the minimum design capacity for treatment, EPA determined that some model sites would contract for off-site disposal of wastewater rather than treat it on site. If off-site disposal was less expensive than treatment on site, EPA assumed the site would dispose of the wastewater off site. EPA compared off-site disposal versus on-site treatment for individual technologies and their influent flow rates, rather than on the total site wastewater treatment system. For example, a site may find it less expensive to contract for off-site disposal of cyanide-bearing wastewater than to install and operate a cyanide destruction treatment system. However, it would still be less expensive to treat all other wastewater streams on site. To determine whether treatment on site was less expensive then contracting for off-site disposal, EPA compared total annualized costs assuming an equipment life expectancy of 15 years and an annual interest rate of 7 percent.

EPA used MP&M survey data to determine the unit cost ($/gal or $/lb) to contract for off-site treatment/disposal for various waste types (see Section 6.7.1 of the rulemaking record, DCN 16023). EPA compared the costs of the following technologies to contracting for off-site disposal in lieu of treatment costs:

- Centrifugation and pasteurization of machining coolants;
- Centrifugation of painting water curtains (general metal-bearing waste and paint sludge);
- Chemical reduction of hexavalent chromium;
- Cyanide destruction;
- Chemical reduction of chelated metals;
- Chemical emulsion breaking and gravity oil/water separation;
- Dissolved air flotation;
- Ultrafiltration for oil removal;

- Chemical precipitation and sedimentation; and

- Sludge pressure filtration.

In the case of wastewater requiring chemical precipitation and sedimentation treatment, EPA compared the costs of contracting for off-site disposal of the untreated end-of-pipe wastewater to the cost of the entire treatment system, which includes chemical precipitation, sedimentation (gravity clarification or microfiltration), sludge thickening, and pressure filtration.

Equipment Size Ranges

EPA developed equipment cost equations for each component of the treatment technologies. The equations are valid between the minimum and maximum sizes (e.g., flow rates, volume capacities) from which EPA developed the equations. For wastewater capacities below the minimum range of validity, the cost model designed the equipment at the minimum size. For wastewater capacities above the maximum range of validity, the cost model designed multiple units of equal capacity to operate in parallel.

Batch Schedules

EPA designed either batch or continuous systems, depending on each model site's operating schedule and discharge flow rate. The Agency also designed wastewater treatment operations such that the minimum system would be operated at capacity. For example, if the minimum cyanide destruction system was 480 gallons per batch, and a site generated 80 gallons of cyanide-bearing wastewater per day, then the cost model designed the cyanide destruction system to treat a 480-gallon batch once every six days.

Dilute Influent Concentrations

In rare cases, high wastewater flow rates at some sites resulted in pollutant concentrations below the long-term average technology effectiveness concentrations (discussed in Section 10.0) even after flow reduction from in-process pollution prevention practices. In these cases, EPA assumed the site did not require treatment to meet the EPA option for that wastewater stream and therefore did not include end-of-pipe costs.

11.4 Specific Methodology and Assumptions Used to Estimate Costs for Treatment Technologies

EPA made many changes in cost model assumptions and methodology made based on comments submitted during both the proposed rule and the NODA comment periods. This subsection describes the changes to proposal methodology and assumptions that EPA used to estimate both the costs presented in the NODA and those developed for the final rule. The methodology and assumptions used for the costs presented in the Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products & Machinery

Point Source Category (EPA 821-B-00-005) are discussed in that document. EPA updated information regarding unit operations, discharge status, operating schedule, and flow throughout the costing effort, based on industry comments and corrections to submitted survey data.

11.4.1 NODA Cost Estimates

For the costs presented in the NODA, EPA revised the following inputs and logic of the proposed cost model:

- Pollutant concentration;
- Subcategorization scheme;
- Discharge status;
- Wastewater treatment determination;
- Wastewater flow;
- Treatment modules;
- Statistical weighting factors; and
- Post processing.

EPA also added an option: upgrading treatment from 40 CFR 413 standards to those of 40 CFR 433. The remainder of this subsection describes all these changes in detail.

Pollutant Concentrations

EPA revised the calculation of pollutant concentrations from unit operations. First, the Agency incorporated additional data submitted with comments and from the Phase III sampling (see Section 3.0 for details on data sources). Next, EPA reclassified sampling data unit operations, including revising one sample point to be a drag-out rinse and adding more printed wiring board unit operations (see Section 12.0 for details). See Section 24.7 of the rulemaking record, DCN 17890, for details of these changes.

Subcategorization Scheme

In response to industry comments, EPA made the following adjustments to the subcategorization scheme for analyses presented in the NODA:

- Printed Wiring Board Assembly facilities in the Metal Finishing Job Shops Subcategory were moved to the General Metals Subcategory. Facilities that perform only Printed Wiring Board Assembly operations remained in the General Metals Subcategory.

- Printed Wiring Board Job Shops were moved from the Metal Finishing Job Shops Subcategory into the Printed Wiring Board Subcategory.

- Additional unit operations were included in the Oily Wastes Subcategory based on new sampling data and data submitted with comments.

- Zinc platers were defined and segregated from the General Metals and Metal Finishing Job Shops Subcategories for some analyses for EPA's consideration of a zinc platers subcategory or segment.

Discharge Status

For NODA analyses, EPA revised the discharge status determination for sites submitting MP&M Phase I surveys to better reflect the MP&M Phase II discharge status hierarchy. The discharge status for all sites was thus based on the following assumptions:

- EPA considered a site with a direct discharging stream as direct, regardless of any indirect or zero-discharging streams (i.e., all streams at the site were considered to be direct);

- EPA considered a site with an indirect discharging stream and no direct streams as indirect, regardless of any zero-discharging streams; and

- EPA considered a site with no direct or indirect streams a contract-haul, reuse, or zero-discharge site.

Wastewater Treatment Determination

EPA updated the treatment in place based on the following additional comment data and new assumptions:

- In response to industry comments, EPA considered end-of-pipe ion exchange equivalent to cyanide destruction for sites discharging cyanide-bearing wastewater. See Section 20.3 of the rulemaking record, DCN 17947, for the industry comment information.

- For sites responding to the Short and Municipality Surveys, EPA no longer considered neutralization/pH adjustment equivalent to chemical precipitation. EPA considered only neutralization/pH adjustment with clarification or sludge removal equivalent to chemical precipitation.

- EPA assumed that sites with baseline pollutant concentrations less than the option technology pollutant concentrations did not require any additional treatment.

- EPA verified cost model input database accuracy versus the site surveys and resolved inconsistencies, such as stream discharge destination.

Wastewater Flow

EPA revised flow imputations for sites not reporting unit operation discharges. The sum of imputed flows was verified to be less than the total reported facility flow, where available. Additionally, EPA excluded recirculated flow from the imputation to reduce the potential for overinflated imputations. See Section 16.6.1 of the rulemaking record, DCN 27711.

Statistical Weighting Factors

EPA incorporated new statistical weighting factors. The Agency adjusted some Phase I survey weights to account for additional zero dischargers and to exclude ineligible facilities. See Section 19.5 of the rulemaking record, DCN 36086.

Post Processing

EPA adjusted model logic, allowing treatment costs to be estimated on individual wastestreams for the Railroad Line Maintenance and Steel Forming and Finishing Subcategories. EPA also allowed for cost savings from the addition of pollution prevention technologies.

40 CFR 413 to 433 Upgrade Analysis

To consider the industry comment that the proposed standards were too stringent, EPA examined a new option: to upgrade from the 40 CFR 413 standards to 40 CFR 433 standards. EPA approximated compliance costs and load reductions associated with upgrading facilities from the Electroplating (40 CFR 413) rule to the Metal Finishing (40 CFR 433) rule. The 40 CFR 413 rule, promulgated in 1981, is based on older technology than the 40 CFR 433 rule, promulgated in 1983. Section 9.0 presents the option technology associated with the Part 413 to 433 Upgrade Analysis. Section 11.5 discusses how EPA estimated costs for each component of the option technology, and Section 12.0 discusses how EPA estimated the pollutant loadings reductions associated with the Upgrade Analysis.

11.4.2 Post-NODA Cost Estimates

Following receipt of industry comment on the analyses presented in the NODA, EPA revised parts of the costing approach. The remainder of this subsection describes the changes made between the NODA and promulgation: how EPA incorporated new data received and revised assumptions and parts of the costing methodology.

Treatment Modules Updates

EPA revised and updated treatment modules. Most notably, EPA added monitoring costs for tin, sulfide, and lead for all sites. EPA revised the off-site disposal methodology to haul nickel-bearing wastewater prior to chemical precipitation if the model determines not to treat via chemical precipitation and sedimentation. EPA also added costs for sand (multimedia) filters as a technology option. For more details on these and other revisions, refer to Section 16.6.1, DCN 16741, and Section 24.6.1, DCN 17935, of the rulemaking record.

Discharge Status

Post-NODA, EPA altered its discharge status determination to allow a site to have multiple discharge statuses (e.g., direct discharge, indirect discharge, and zero discharge). The approach was changed to more accurately reflect the actual site situation. At the time of the proposed rule and the NODA, EPA classified discharge status for an entire site, instead of each wastestream. For analyses after the NODA, EPA assigned a discharge status to each wastewater treatment system.

Flow Estimates

EPA revised the flow imputation methodology used to estimate flows for sites that did not provide them. The new methodology allowed for zero discharge as a possible imputation result. See Section 28.2 of the rulemaking record, DCN 36200 for more detail on imputed flows.

Treatment in Place

In response to industry comments to ensure proper consideration of the baseline treatment in place, EPA reconsidered additional treatment technologies equivalent to the option technologies:

- EPA now considers end-of-pipe and in-process ion exchange equivalent to cyanide destruction for cyanide-bearing wastestreams without any other cyanide treatment;

- EPA now considers end-of-pipe and in-process ion exchange equivalent to chemical precipitation plus a filter press for metals-bearing wastestreams without other metals treatment;

- Dissolved air flotation is considered equivalent to chemical precipitation treatment for metals-bearing wastestreams without other metals treatment for the 413 to 433 Upgrade option;

- Any type of oily wastewater treatment (e.g., belt skimming) is equivalent to chemical emulsion breaking and oil/water separation; and

- The presence of a holding tank and sludge removal after some chemical addition is now considered equivalent to chemical precipitation followed by clarification.

11.5 Costing Methodologies for Direct Discharging Oil-Bearing Subcategories

Commentors supplied additional DMR and sampling data during the post-proposal and post-NODA comment periods. Due to the small number of model facilities in each of the oil-bearing subcategories and the high percentage of supplied DMR sampling data, EPA was able to use site-specific effluent discharge information as a major part of the costing process. (One hundred percent of the direct discharging railroad line maintenance facilities supplied sampling data and some associated sampling frequency information. Ninety-two percent of the direct discharging oily wastes facilities, with treatment in place, supplied sampling data and some associated sampling frequency information. Fifty percent of the shipbuilding dry dock facilities supplied sampling data and some associated sampling frequency information.) The methodology used in each of the oil-bearing subcategories is discussed below.

11.5.1 Oily Wastes Costing Methodology

For the Oily Wastes Subcategory, EPA calculated the costs for the final rule through the following methodology. If a model site had provided DMR data, it was reviewed to determine baseline compliance with the final MP&M LTAs. If the data indicated the model site was currently meeting the LTAs, no additional costs were applied to the site. If the DMR data indicated the model site was not currently meeting the LTAs, and the survey indicated that the facility had Option 6 technology (or equivalent) in place, then the cost model output was reviewed. If the model determined that pollution prevention (P2) could be added to the site, then only P2 costs were assigned. It was assumed that adding P2 would lower the flow into the treatment system and help increase the system removals. If the site already had P2 in place, then a one-time upgrade cost was added. This upgrade cost was intended to help the facility better operate their treatment system through use of a consultant, subsequent operator training, and some additional treatment control equipment. The upgrade was considered a capital cost and totaled $10,700 ($2001). This is made up of the costs listed below (for more details on how each of these costs were derived, see DCN 17906 located in Section 24.6.1 of the rulemaking record):

- $5,500 for consultant fees;
- $2,200 for operation training; and
- $3,000 for a new pH meter.

If the DMR data indicated the model site was not currently meeting the LTAs, and the survey indicated that the facility did not have Option 6 technology (or equivalent) in place, then the cost model output was used.

If the model site did not have DMR data, it was reviewed to determine the level of treatment in place. If the survey indicated the facility did have Option 6 technology (or equivalent) in place, then EPA set the baseline discharge concentrations to the median of the DMR data. Because the calculated medians for oil and grease and TSS were below the final MP&M LTA's, no additional costs were added. (Note that, if they had been above the final MP&M LTA's, then EPA would have added a one-time upgrade cost.) If the survey indicated the facility did not have Option 6 technology (or equivalent) in place, then the cost model output was used.

11.5.2 Railroad Line Maintenance Costing Methodology

For the Railroad Line Maintenance (RRLM) Subcategory, the AAR survey information discussed in Section 3.0 was used. Each survey contained information on effluent concentrations, flow, and treatment currently in place. The AAR surveys indicated that all direct discharging facilities in the RRLM Subcategory currently use wastewater treatment equivalent to or better than Option 6. Additionally, most of the facilities have NPDES daily maximum permit limitations for oil and grease (as HEM) and TSS as 15 and 45 mg/L, respectively. Based on this information, EPA concluded that these oil and grease (as HEM) and TSS daily maximum limits represent the average of the best performances of facilities utilizing Option 6 technology.

EPA evaluated the compliance costs associated with establishing BPT daily maximum limitations equivalent to 15 and 45 mg/L for oil and grease (as HEM) and TSS, respectively, and concluded all facilities currently meet a daily maximum oil and grease limit of 15 mg/L and most currently monitor once per month. With one exception, all facilities are currently meeting a TSS daily maximum limit of 45 mg/L. If EPA had decided to develop Part 438 limitations for this subcategory, it would have estimated incremental costs associated with bringing this one facility into compliance with the TSS limit.

11.5.3 Shipbuilding Dry Dock Costing Methodology

No additional costs were estimated for this subcategory. Following proposal, EPA received comments and supporting data indicating that its estimates of current pollutant discharges from this subcategory were overestimated. In particular, commentors claimed that current discharges of oil and grease were minimal and that national regulation was not warranted for this subcategory. EPA incorporated the additional information provided by commentors into its analysis and now concludes that direct discharges from these facilities generally contain minimal levels of all pollutants. In particular, current oil and grease discharges from these facilities are not detectable (< 5 mg/L) or nearly not detectable. EPA has similarly determined that TSS discharges are, on average, minimal. The data show that TSS discharges may increase episodically, particularly when the dry dock is performing abrasive blasting operations. However, EPA has concluded that these episodic discharges from six facilities do not warrant national regulation. If EPA had decided to develop Part 438 limitations for this subcategory, it would have estimated incremental costs associated with lowering and/or controlling the episodic TSS discharges.

11.6 <u>Design and Costs of Individual Pollution Control Technologies</u>

This subsection discusses in detail the design and costing of the individual technologies that compose the technology options. Table 11-13 presents the capital and annual cost equations for the specific equipment mentioned in each technology description below. When tanks were a component of an option, EPA estimated that each wastestream would need only one tank, unless the technology required a reserve tank, such as chemical emulsion breaking. EPA estimated the tank volume needed based on Equation 11-2 in Section 11.2.4. The remainder of this subsection describes the tank requirements of each individual technology. Additional documentation is available in Section 24.6.1 of the rulemaking record, DCN 17885.

11.6.1 Countercurrent Cascade Rinsing

The Agency estimated costs for countercurrent cascade rinses for flowing rinses at the model sites. The countercurrent cascade rinse module estimates a cost and flow reduction associated with the conversion to a two-stage countercurrent rinse. Section 15.2.4 gives more information on countercurrent cascade rinsing flow reduction as related to the site's existing rinse scheme.

EPA estimated capital and annual costs based on the model site's current rinse schemes. The module included capital and annual costs for the following equipment when necessary.

- A second rinse tank with a volume equal to the volume of the existing tank;
- Transfer pumps and piping; and
- An air-agitation system.

EPA assumed there would not be additional O&M costs for replacing the current rinse scheme with a two-stage countercurrent cascade rinse. Direct annual costs for this module included increased energy costs but a reduced water cost due to water-use reduction. EPA calculated the water savings obtained from converting the rinse to countercurrent cascade and used a water cost of $2.03 per 1,000 gallons to subtract the cost savings from the site's total annual cost.

11.6.2 Centrifugation and Pasteurization of Machining Coolant

EPA estimated costs for centrifugation and pasteurization of machining coolant for machining and grinding operations discharging water-soluble or emulsified coolant (listed in Table 11-13). EPA estimated the costs of a liquid-liquid separation centrifuge to remove solids and tramp oils and a pasteurization unit to reduce microbial growth. The costed systems included the following equipment in Table 11-13:

- High-speed, liquid-liquid separation centrifuge;
- Pasteurization unit; and
- Holding tanks for large-volume applications.

EPA provided a 50-percent excess capacity to account for fluctuations in production resulting from flow rates greater than 14 gallons per minute. The Agency developed capital and annual cost estimates from vendor data on packaged systems of different capacities. Direct annual costs included O&M labor and materials, energy costs, sludge and waste oil disposal costs, and a cost credit for water- and coolant-use reduction. EPA estimated maintenance labor at one hour per week and operating labor at one hour per shift.

Based on site visit and vendor information, EPA assumed that this technology can reduce coolant discharge by 80 percent. The Agency based the amount of coolant and water saved on the model site recycling 80 percent of the coolant and discharging a 20-percent blowdown stream to oil treatment. From site visit and vendor information, EPA estimated the coolant solution to be 95 percent water and 5 percent coolant.

11.6.3 Centrifugation of Painting Water Curtains

EPA estimated costs for centrifugation of painting water curtains (listed in Table 11-13), which included a centrifuge and a holding tank large enough to hold flow for one hour. Direct annual costs included O&M labor and materials, energy costs, sludge disposal costs, and a cost credit for water-use reduction. EPA estimated maintenance labor at one hour per week and operating labor at one hour per shift.

EPA assumed that a model site reused all water discharged from the centrifugation system in painting operations, and contracted for off-site disposal of the sludge from the system. EPA estimated off-site disposal costs using the average paint sludge hauling costs reported in the 1996 MP&M Detailed Survey. Because actual disposal costs depend more on site-specific conditions (e.g., paint type and spray-gun cleaner requirements) than RCRA hazard classification, EPA estimated costs by averaging the costs for RCRA hazardous and nonhazardous paint sludges together. (See Table 11-14 for off-site disposal costs and Section 11.6.4 for more detailed information.)

Table 11-13

MP&M Equipment Cost Equations[a]

Equipment	Equation	Range of Validity
Countercurrent cascade rinsing	**A** = [(0.0004 x TANKVOL + 0.2243)] x DPY x HPD x 0.047 - [(Y-CCFLOW) x 60 x HPD x DPY x 0.00203]	
	C = 6.047 x TANKVOL + 3,784.3; Tank, piping, and pump	
	C = 0.5077 x TANKVOL + 1077.8; Piping and pump	
	C = 8 x 29.67; Labor only	
Machine coolant regeneration system (including holding tanks)	**A** = [18 x 0.047 x DPY x HPD x NUM] + [(HPD/8) x DPY x 29.67 x NUM] + [(DPY/5) x 29.67 x NUM] + [0.002 x Y x 60 x HPD x DPY x 1.95]+ [0.05 x Y x 60 x HPD x DPY x 0.86] - [0.05 x 0.80 x Y x 60 x HPD x DPY x 9.03] - [0.95 x 0.8 x Yx 60 x HPD x DPY x 0.00203]	$Y \leq 14$
	C = 41,422	$Y \leq 1$
	C = 110,205	$1 < Y \leq 2$
	C = 142,831	$2 < Y \leq 6$
	C = 164,009	$6 < Y \leq 10$
	C = 191,331	$10 < Y \leq 14$
Paint curtain centrifuge	**A** = [0.047 x KW x HPD x DPY] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67] + [TSS x 3.785/106 x 2.2/0.4 x Y x 60 x HPD x DPY/8.5 x 3.7] - [(Y x 60 x HPD x DPY) - (TSS x 3.785/10^6 x 2.2/0.4 x Y x 60 x HPD x DPY/8.35)] x 0.00203	$Y \leq 53$
	C = 7,254 (kW = 0.4)	$Y \leq 8$
	C = 10,325 (kW = 1.5)	$8 < Y \leq 13$
	C = 47,104 (kW = 2.2)	$13 < Y \leq 26$
	C = 62,936 (kW = 3.7)	$26 < Y \leq 53$

Table 11-13 (Continued)

Equipment	Equation		Range of Validity
Feed system, aluminum sulfate (alum)	**A** =	0.35 x 0.7456 x HPD x DPY x 0.047	Y < 10
	C =	6,622	Y ≤ 1
	C =	142.88 x Y + 6,412	1 < Y < 10
	A =	[1.36 x HPD x DPY x 0.047] + [0.0006615 x Y x 60 x HPD x DPY] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67]	10 ≤ Y < 350
	A =	[1.49 x HPD x DPY x 0.047] + [0.0006615 x Y x 60 x HPD x DPY] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67]	Y ≥ 350
	C =	9.7882 x Y + 9,718.7	10 ≤ Y ≤ 350
Feed system, calcium chloride, continuous	**A** =	[[(0.0061 x Y) + 1.1696] x HPD x DPY x 0.047] + [0.00125 x Y x 60 x HPD x DPY]	Y ≤ 350
	C =	10,299	Y ≤ 10
	C =	28.805 x Y + 10,683	10 < Y ≤ 350
Feed system, calcium hydroxide (lime), continuous	**A** =	0.25 x 0.7456 x HPD x DPY x 0.047	Y < 10
	C =	8,489	Y ≤ 1
	C =	47.713 x Y + 8,445	1 < Y < 10
	A =	[[(0.0006 x Y) + 1.2961] x HPD x DPY x 0.047] + [0.000117 x Y x 60 x HPD x DPY]	10 ≤ Y ≤ 350
	C =	24.586 x Y + 12,830	
Feed system, ferric sulfate, continuous	**A** =	0.35 x 0.7456 x HPD x DPY x 0.047	Y < 10
	C =	5,200	Y ≤ 1
	C =	52.991 x Y + 5,118	1 < Y < 10
	A =	[[(0.0009 x Y)+ 1.3313] x HPD x DPY x 0.047] + [0.0000434 x Y x 60 x HPD x DPY]	10 ≤ Y ≤ 350
	C =	11.56 x Y + 9,762.9	

Table 11-13 (Continued)

Equipment	Equation	Range of Validity
Feed system, polymer	**A** = [0.2833 x HPD x DPY x 0.047] + [0.001 x Y x 60 x HPD x DPY]	Y < 10
	C = 3,686	
	A = [[(0.0034 x Y) + 1.4171] x HPD x DPY x 0.047] + [0.001 x Y x 60 x HPD x DPY]	10 ≤ Y ≤ 350
	C = 20.685 x Y + 9,822	
Feed system, sodium hydroxide, continuous (caustic)	**A** = [0.1864 x HPD x DPY x 0.047] + [0.0042 x Y x 60 x HPD x DPY]	Y < 10
	C = 4,503	
	A = [[(0.0071 x Y) + 1.1584] x HPD x DPY x 0.047] + [0.0042 x Y x 60 x HPD x DPY]	10 ≤ Y ≤ 350
	C = 77.564 x Y + 21,506	
Feed system, sulfuric acid	**A** = [0.0373 x HPD x DPY x 0.047] + [0.000222 x Y x 60 x HPD x DPY]	Y < 10
	C = 4,110	
	A = [[(0.0023 x Y) + 1.683] x HPD x DPY x 0.047] + [0.000222 x Y x 60 x HPD x DPY]	10 ≤ Y ≤ 350
	C = 56.416 x Y + 17,769	
Chemical emulsion breaking, coalescent plate separator (gravity oil/water separator) [requires sulfuric acid, alum, caustic, and polymer feed systems]	**A** = [(0.0019 x Y + 2.009) x 0.7456 x HPD x DPY x 0.047] x NUM + [29.67 x (HPD/8) x DPY] + [(DPY/5) x 29.67] x NUM + [3.664 x Y x HPD x DPY]	Y ≤ 8
	C = 42,261	Y ≤ 2
	C = 3,916.2 x Y + 30,278 + 2,452 x Y +1,132	2 < Y ≤ 8
	A = [(0.096 x Y + 2.039) x 0.7456 x HPD x DPY x 0.047] x NUM + [29.67 x (HPD/8) x DPY] + [(DPY/5) x 29.67] x NUM + [3.664 x Y x HPD x DPY]	8 < Y ≤ 200
	C = 86,720	8 < Y ≤ 15
	C = 845.43 x Y + 65,284 + 2,452 x Y + 1,132	15 < Y ≤ 200
Dissolved air flotation [requires lime, ferric sulfate, and polymer feed systems]	See ultrafiltration for oil removal.	Y < 4.42
	A = [(0.0728 x Y + 3.072) x HPD x DPY x 0.047] + [0.0045 x Y x 60 x HPD x DPY] + [29.67 x HPD x DPY] + [(DPY/5) x 29.67] + [0.86 x 0.0003 x Y x 60 x HPD x DPY] + [0.86 x 0.071 x Y x 60 x HPD x DPY]	4.42 ≤ Y ≤ 350
	C = 1,125.4 x Y + 137,936	

Table 11-13 (Continued)

Equipment		Equation	Range of Validity
Ultrafiltration for oil removal	**A** =	[(0.71 x Y + 5.46) x HPD x DPY x 0.047] + [0.4 x Y + 0.3] + [0.5 x HPD x DPY x29.67] + [(DPY/5) x 29.67] + [65.78 x Y + 193.46] + [(27,123 x Y/(24 x 365 x 60)) x 0.86 x 60 x HPD x DPY]	$Y \leq 406$
	C =	157,700	$Y \leq 8$
	C =	3,596 x Y + 235,146	$8 < Y \leq 406$
Batch oil-emulsion breaking with gravity flotation [requires sulfuric acid, alum, and polymer feed systems]	See dissolved air flotation.		$Y < 100$
	A =	[(0.65 x Y + 49.7) x HPD x DPY x 0.047] + [HPD x DPY x 29.67] + [(DPY/5) x 29.67] + [0.022 x Y x 60 x HPD x DPY x 0.86]	$100 \leq Y \leq 300$
	C =	17,204 x Y + 2,000,000	
Chromium reduction system, sodium metabisulfite	**A** =	[2.4225 x HPD x DPY x 0.047] + [0.002608 x Y x 60 x HPD x DPY] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67]	$Y \leq 45$
	C =	20,892	$Y \leq 1$
	C =	261.7 x Y + 24,249	$1 < Y \leq 45$
Alkaline chlorination with hypochlorite feed system (for cyanide destruction)	**A** =	[4.845 x HPD x DPY x 0.047] + [0.012418 x Y x HPD x DPY x 60] + [0.125 x HPD x DPY x 29.67] + [(DPY/5) x 29.67]	$Y \leq 200$
	C =	28,862	$Y \leq 1$
	C =	29,793 x $Y^{0.19}$	$1 < Y \leq 200$
Chelation breaking with dithiocarbamate treatment	**A** =	[2.4225 x HPD x DPY x 0.047] + [0.000583 x Y x 60 x HPD x DPY] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67]	$Y \leq 45$
	C =	20,892	$Y \leq 1$
	C =	261.7 x Y + 24,249	$1 < Y \leq 45$

Table 11-13 (Continued)

Equipment	Equation		Range of Validity
Chemical precipitation [requires sulfuric acid, caustic, and polymer feed systems]	**A** =	[0.932 x HPD x DPY x 0.047] + [(DPY/5) x 29.67] + [(HPD/8) x DPY x 29.67]	Y < 5
	C =	8,900	Y ≤ 0.5
	C =	626.6 x Y + 8,550	0.5 < Y < 5
	A =	[[(0.0571 x Y) + 0.0123] x HPD x DPY x 0.047] + [(DPY/5) x 29.67] + [(HPD/8) x DPY x 29.67]	5 ≤ Y ≤ 350
	C =	784.54 x Y + 34,216	
Clarifier, slant-plate (lamella)	**A** =	2 x (DPY/5) x 29.67	Y ≤ 400
	C =	9,740	Y < 2
	C =	15,057	2 ≤ Y < 10
	C =	74.896 x Y + 31,401	10 ≤ Y ≤ 400
Filtration, multimedia	**A** =	[[(0.0504 x Y) + 1.0139] x HPD x DPY x 0.047] + [(HPD/8) x DPY x 29.67] + [(DPY/5) x 29.67]	Y ≤ 800
	C =	35,115	Y ≤ 15
	C =	240.85 x Y + 27,269	15 < Y ≤ 800
Microfiltration system for metals removal	**A** =	[(0.3 x Y + 6.3) x HPD x DPY x 0.047] + [3.4 x Y] + [0.5 x HPD x DPY x 29.67] + [(DPY/5) x 29.67] + [184.2 x Y + 155.2]	Y ≤ 400
	C =	74,081	Y ≤ 5
	C =	1,728.3 x Y + 69,337	5 < Y ≤ 400
Sludge thickening	**A** =	[0.246 x HPD x DPY x 0.047] + [2 x (DPY/5) x 29.67]	Y < 0.5
	C =	74.306 x Y x 60 + 3,746	
	A =	[3.7 x HPD x DPY x 0.047] + [2 x (DPY/5) x 29.67]	0.5 ≤ Y ≤ 45
	C =	2334.8 x Y + 77,429	

Table 11-13 (Continued)

Equipment	Equation		Range of Validity
Filter press, plate-and-frame	**A** =	[(60 + (30 x DPY x 2)) x NUM] + [FT3 x DPY x 7.48 x 1.95]	CFT3 ≤ 6
	A =	[(60 + (60 x DPY x 2)) x NUM] + [FT3 x DPY x 7.48 x 1.95]	CFT3 ≤ 12
	A =	[(60 + (90 x DPY x 2)) x NUM] + [FT3 x DPY x 7.48 x 1.95]	CFT3 > 12
	C =	[1,658.8 x FT3] + 17,505	0.85 < FT3 ≤ 76.5

[a]All costs are calculated in 2001 dollars.

Variable Definitions:

C	- Direct capital costs (1996 dollars).
A	- Annual costs (1996 dollars).
Y	- Influent equipment flow (gallons per minute).
HPD	- Operating hours per day.
DPY	- Operating days per year.
FT3	- Daily cake volume (FT^3) from all presses.
IPFLOW	- GPH
TANKVOL	- Volume of countercurrent rinsing tank (gallons).
CCFLOW	- Flow rate after countercurrent rinsing is supplied (gallons per minute).
kW	- Kilowatts.
CFT3	- Cake volume (FT^3) per cycle per press (assume two cycles per day).
NUM	- Number of units.
TSS	- Influent TSS concentration (mg/L).

11.6.4 Contracting for Off-Site Treatment and Disposal

The Agency estimated costs for off-site treatment and disposal of various types of wastes generated on site. These waste types include:

- Painting and paint stripping/solvent wastewater;
- Paint sludge;
- Wastewater containing oil and grease and organic pollutants;
- Waste oils/sludges;
- Chromium-bearing wastewater;
- Cyanide-bearing wastewater;
- Chelated metal-bearing wastewater;
- General metal-bearing wastewater; and
- Metal-bearing sludge.

Except for F006 hazardous waste, EPA estimated costs for off-site transportation and treatment/disposal of each waste type in dollars per gallon of waste using averages of cost data provided in the 1996 MP&M Detailed Survey for off-site disposal of specific wastewater streams. EPA applied these costs throughout the cost model using the logic in Table 11-14.

11.6.5 Feed Systems and Chemical Dosages

Feed systems are components of almost every option technology. EPA developed three types of cost modules for feed systems: treatment-specific, generic, and low-flow. EPA determined dosage, equipment, and other design specifics for treatment-specific feed systems, whenever data were available. For feed systems with no specific information available, EPA developed a generic feed system module, using literature or engineering judgement to select dosages and equipment. For feed systems with low-flow treatment systems, EPA developed low-flow polymer, sodium hydroxide, sulfuric acid, alum, lime, and ferric sulfate feed modules, with lower fixed capital and energy costs for flow rates of less than 600 gallons per hour. EPA also developed lower energy costs for alum feed systems with flow rates below 350 gallons per minute. Table 11-15 lists the treatment technologies that use feed systems.

Table 11-14

Logic Used for Off-Site Treatment and Disposal Cost Estimates

Type of Waste	Estimated Cost	Data Source
Painting and paint stripping wastewater	$2.85 per gallon	Costs for off-site disposal of solvent-bearing wastewater as reported in the 1996 MP&M Detailed Survey
Paint sludge generated by the painting water curtain centrifugation system	$3.70 per gallon	Average values reported in the 1996 MP&M Detailed Surveys for hazardous and nonhazardous waste
Wastewater bearing oil and grease or other organic pollutants	$1.33 per gallon	Values reported in the 1996 MP&M Detailed Survey
Waste oil generated by machining coolant centrifugation and pasteurization, chemical emulsion breaking and gravity oil/water separation, dissolved air flotation, and ultrafiltration	$0.86 per gallon	Values reported in the 1996 MP&M Detailed Survey
Waste sludge generated by dissolved air flotation	$0.86 per gallon	Values reported in the 1996 MP&M Detailed Survey
Hexavalent chromium-bearing wastewater	$3.51 per gallon	Values reported in the 1996 MP&M Detailed Survey
Cyanide-bearing wastewater	$5.64 per gallon	Values reported in the 1996 MP&M Detailed Survey
Chelated metal-bearing wastewater	$1.40 per gallon	Values reported in the 1996 MP&M Detailed Survey
Metal-bearing wastewater	$2.00 per gallon	Values reported in the 1996 MP&M Detailed Survey
Metal-bearing sludge, generated by the sludge pressure filtration system and the machining coolant centrifugation and pasteurization system	$1.95 per gallon	The value reported in Pollution Prevention and Control Technology for Plating Operations (4) for F006 hazardous wastes

Additional details are provided in Section 6.7.1 of the rulemaking record, DCN 16023.

Table 11-15

Treatment Technologies That Use Feed Systems

Treatment Technology	Feed Systems Required
Chemical emulsion breaking and gravity oil/water separation	Sulfuric acid Polymer Alum
Dissolved air flotation	Lime Ferric sulfate Polymer
Batch oil emulsion breaking with gravity flotation	Polymer Sulfuric acid Alum
Chemical reduction of hexavalent chromium	Sulfuric acid Sodium metabisulfite
Cyanide destruction	Sodium hydroxide Sulfuric acid Sodium hypochlorite
Chemical reduction/precipitation of chelated metals	Sulfuric acid Dithiocarbamate
Chemical precipitation	Sulfuric acid Polymer Caustic

Sources: Pollution Prevention and Control Technology for Plating Operations (4) and MP&M Sampling Data.

To determine the required chemical dosage for each technology, the Agency used either the Pollution Prevention and Control Technology for Plating Operations (4) or chemical usage data from sampled MP&M sites with the option technology in place. Table 11-16 lists the chemical dosage used to estimate costs and the source from which the dosage was derived.

Capital and annual costs from feed systems were not reported individually in cost model outputs but were added into the overall treatment system capital and annual costs. The cost model included the capital and annual costs for the following equipment in the feed system capital costs:

- Raw material storage tank;
- Day storage tank with mixer;
- Chemical metering pumps;
- pH controller; and
- Supporting piping and valves.

Table 11-16

Treatment Dosage Information

Feed system	Chemical Concentration Required (mg/L)	Data Source
Polymer feed system	20	(4)
Continuous sodium hydroxide feed system	1,685	(4)
Continuous hydrated lime feed system	376	(4)
Continuous sulfuric acid feed system	699	(4)
Continuous ferric sulfate feed system	74	(5)
Continuous aluminum sulfate (alum) feed system	648	(5)
Continuous calcium chloride feed system	830	(4)

Sources: Pollution Prevention and Control Technology for Plating Operations (4) and MP&M Sampling Data.

11.6.6 Chemical Emulsion Breaking and Gravity Oil/Water Separation

EPA estimated costs for chemical emulsion breaking and gravity oil/water separation systems to separate and remove oil and grease and TSS. The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment. Table 11-12 lists the unit operations that discharge wastewater streams that feed oil removal treatment units.

For chemical emulsion breaking systems, the module included capital and annual costs for the following equipment:

- Flow equalization tank;
- Two emulsion breaking tanks;
- Two mixers;
- Sulfuric acid feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Alum feed system (see Section 11.6.5);
- Sodium hydroxide feed system (see Section 11.6.5); and
- Wastewater pumps.

Emulsion breaking was followed by oil removal using a coalescent plate separator. For oil removal systems, EPA estimated capital and annual costs for the following equipment:

- Feed pumps;
- Belt skimmer; and
- Oil/water separator.

Direct annual costs included O&M labor and materials, energy costs, raw materials (e.g., sulfuric acid, alum, polymer, sodium hydroxide), and waste oil disposal costs. EPA also included costs for off-site reclamation of waste oil. EPA also estimated waste oil generation to be 7.1 percent of the influent flow, based on MP&M survey data.

11.6.7 Dissolved Air Flotation

For the Shipbuilding Dry Dock Subcategory, EPA estimated costs for dissolved air flotation systems to separate and remove oil and grease, suspended solids, and organic pollutants. The Agency assumed that shipbuilding model sites commingled all oil-bearing wastewater streams prior to treatment.

The module included capital and annual costs for the following equipment:

- Flow equalization tank;
- Feed pumps;
- Oil/water separator;
- Chemical treatment tank;
- Lime feed system (see Section 11.6.5);
- Ferric sulfate feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Dissolved air flotation system with pressure tank and programmable logic controller (PLC);
- Oil storage tank; and
- Final pH adjustment tank.

Direct annual costs included O&M labor and materials, energy costs, raw materials (e.g., hydrated lime, ferric sulfate, polymer), and waste oil and sludge disposal costs. EPA also estimated costs for off-site reclamation of the waste oil and sludge. Hydrated lime and ferric sulfate flows were added to the discharge flow, while polymer volume was considered negligible. EPA estimated generation of waste oil and sludge as 7.1 and 0.03 percent of the influent flow, respectively, based on the MP&M survey data. Because dissolved air flotation systems are not typically used for flow rates of less than 265 gallons per hour (gph), EPA estimated costs for ultrafiltration oil removal for model sites with flows of less than 265 gph.

11.6.8 Ultrafiltration System for Oil Removal

EPA estimated costs for ultrafiltration systems to separate and remove oil and grease, suspended solids, and organic pollutants. This technology differs from chemical emulsion breaking with oil/water separation, which was used to develop Option 6 costs (see 11.6.6). The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment and that flow rates greater than the maximum costed system (406 gallons per minute) required multiple systems.

The module included capital and annual costs for the following equipment:

- Spiral-wound membrane filtration modules;
- Process and chemical tanks;
- Steel skid;
- Recirculation tank;
- Recirculation pump;
- Bag filter;
- Fix-mounted cleaning system;
- Sludge pump; and
- Electrical components (pH control/monitoring, temperature control, flow meter, pressure gauges).

Direct annual costs included O&M labor and materials, energy costs, cleaning chemicals, membrane replacement, and waste oil disposal costs. EPA estimated costs for off-site reclamation of waste oil. EPA estimated waste oil generation as 5.2 percent of the influent flow, based on MP&M survey data.

11.6.9 Batch Oil Emulsion Breaking with Gravity Flotation

EPA estimated costs for batch oil emulsion breaking with gravity flotation systems to separate and remove oil and grease, suspended solids, and organic pollutants. This technology differs from chemical emulsion breaking with oil/water separation, which was used to develop Option 6 costs (see 11.6.6). Gravity flotation uses a large tank, with oil recovered over weirs, and is typically seen at large sites such as automotive manufacturing. The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment.

Although batch emulsion breaking with gravity flotation is not part of the MP&M technology options, EPA estimated baseline operating costs and pollutant removals for sites that had this technology in place at baseline. The module included capital and annual costs for the following equipment:

- Polymer feed system (see Section 11.6.5);
- Sulfuric acid feed system (see Section 11.6.5);
- Alum feed system (see Section 11.6.5);
- Two mechanically cleaning bar screens;
- Three batch wastewater treatment tanks;
- Two segregated waste tanks;
- Three skim and saleable oil storage tanks;
- Two oil cooking tanks;
- Pumps;
- One air compressor;
- Six mixers (segregation, saleable oil, and oil cooker tanks); and
- Ancillary equipment (pipes and valves, heat trace, controls, and programmable logic controller (PLC)).

Direct annual costs included O&M labor, energy costs, raw materials (e.g., polymer, sulfuric acid, alum), and waste oil disposal costs. EPA also estimated costs for off-site reclamation of waste oil. Flows from sulfuric acid and alum were added to the treatment flow, while the polymer volume was considered negligible. EPA assumed the model sites discharged treatment effluent to the chemical precipitation and sedimentation system. EPA estimated generation of waste oil as 2.2 percent of the influent flow, based on MP&M survey data. This technology is typically used for flow rates of greater than 6,000 gallons per hour, whereas dissolved air flotation is used for flow rates of between 265 and 6,000 gallons per hour and ultrafiltration for oil removal for flow rates of less than 265 gallons per hour.

11.6.10 Chemical Reduction of Hexavalent Chromium

EPA estimated costs for batch and continuous systems to reduce hexavalent chromium to trivalent chromium prior to chemical precipitation and sedimentation. Note that the sedimentation portion of this treatment is discussed in Section 11.6.14. The Agency assumed that model sites commingled all chromium-bearing wastewater streams prior to treatment and that all chromium in the wastewater was in the hexavalent form.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Fiberglass reaction tank;
- Mixer;
- Sulfuric acid feed system;

- Sodium metabisulfate feed system;
- Flow equalization tank;
- Effluent pump; and
- pH and oxidation-reduction potential (ORP) meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sulfuric acid, sodium metabisulfite). EPA based flow-dependent costs on the volume of wastewater from chromium-bearing unit operations flowing into the system, before treatment chemicals were added to the flow. EPA assumed model sites discharged the treatment effluent to the chemical precipitation and sedimentation system.

11.6.11 Cyanide Destruction

EPA estimated costs for batch and continuous alkaline chlorination systems to destroy cyanide prior to chemical precipitation and sedimentation. The Agency assumed that model sites commingled all cyanide-bearing wastewater streams prior to treatment and did not send cyanide-free wastewater streams to the cyanide destruction system.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Two reaction tanks (batch treatment uses a single tank, with the second tank operating as a batch-holding tank);

- Mixers;

- Sodium hydroxide feed system;

- Sulfuric acid feed system;

- Sodium hypochlorite feed system;

- Effluent pumps; and

- pH and ORP meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sodium hydroxide, sulfuric acid, sodium hypochlorite). EPA based flow-dependent costs on the volume of wastewater from cyanide-bearing unit operation flowing into the system, before treatment chemicals were added to the flow. The Agency assumed model sites discharged the treatment effluent to the chemical precipitation and sedimentation system. EPA also assumed that all other pollutant concentrations remained unchanged in this treatment unit.

11.6.12 Chemical Reduction/Precipitation of Chelated Metals

EPA estimated costs for batch and continuous chemical reduction/precipitation of chelated metal systems to break and precipitate electroless plating complexes (e.g., copper or nickel complexes) prior to chemical precipitation and sedimentation. The Agency assumed that model sites commingled all chelated metal-bearing wastewater streams prior to treatment.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Fiberglass reaction tank;
- Mixer;
- Sulfuric acid feed system;
- Dithiocarbamate feed system (see Section 8.4.4);
- Flow equalization tank;
- Effluent pump; and
- pH and ORP meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sulfuric acid, dithiocarbamate). EPA based flow-dependent costs on the volume of wastewater from chelated metal-bearing unit operations flowing into the system, before treatment chemicals were added to the flow. The Agency assumed that model sites discharged treatment effluent to the chemical precipitation and sedimentation system. Based on analytical data for the systems EPA sampled, EPA assumed that concentrations of carbon disulfide and dithiocarbamate increased across the system.

11.6.13 Chemical Precipitation

The Agency estimated costs for continuous chemical precipitation systems. EPA estimated costs for low-flow systems for model sites with influent flow rates of less than or equal to 300 gallons per hour. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by this technology, except for wastewater from the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories. In addition, EPA assumed that sites would contract for off-site disposal of solvent-bearing wastewater.

The module included capital and annual costs for the following equipment:

- Sulfuric acid feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Caustic feed system (see Section 11.6.5);
- Equalization tank;
- Rapid-mix tank for precipitation;
- Flocculation tank;
- Final pH-adjustment tank;
- System feed pumps; and
- Rapid and flocculation mixers.

Direct annual costs included O&M labor, energy costs, and raw materials (e.g., sulfuric acid, polymer, caustic). The module assumed that the amount of TSS leaving the chemical precipitation system was equivalent to the sum of influent TSS and the dissolved solids that are converted to suspended solids when caustic is added to the wastewater. The approach for calculating suspended solids generated from dissolved solids is documented in Section 6.7.1 of the rulemaking record, DCN 16363. EPA estimated that the effluent flow rate from this system equaled the influent flow rate because additional flow from treatment chemical addition was negligible. EPA designed the cost model to include recycled water from the sludge thickener and filter press. In addition, the Agency assumed that model sites discharged effluent from the chemical precipitation system to either clarification or microfiltration.

11.6.14 Sedimentation by Slant-Plate Clarifier

The Agency estimated costs for sedimentation using slant-plate (lamella) clarifier systems. EPA estimated costs for low-flow systems for model sites with influent flow rates of less than or equal to 600 gallons per hour. EPA designed this system to treat effluent from the chemical precipitation system.

The module included capital and annual costs for the following equipment:

- Slant-plate clarifier; and

- One-time training costs for operators to meet MP&M clarifier limits instead of the baseline 40 CFR 433 Metal Finishing effluent guideline limits (see Section 24.6.1, DCN 17906, of the rulemaking record).

EPA estimated costs associated with achieving long-term average effluent concentrations for all pollutants treated by chemical precipitation with clarification (see Section 10.3). EPA calculated the amount of sludge generated using model-calculated site-specific influent pollutant concentrations for the commingled wastewater. The Agency assumed the sludge was 3 percent solids (5) and was discharged to a sludge-thickening tank (see Section 11.6.17) and that model sites discharged treatment effluent to surface water or a POTW. Direct annual costs included maintenance labor and materials. EPA included costs for operating labor in the chemical precipitation module and included costs for pumps in the chemical precipitation and the sludge-thickening modules.

11.6.15 Multimedia Filtration

The Agency estimated costs for a multimedia filter to continuously remove filterable suspended solids. The system was designed as a polishing step for effluent from the clarifier. Although EPA did not include this technology in the MP&M technology options, it estimated baseline operating costs and pollutant removals for sites that had multimedia filters in place at baseline.

The module included capital and annual costs for the following equipment:

- Multimedia filter skid;
- Holding tank for clarifier effluent (clear well); and
- Media filter feed pump.

Based on data collected during an MP&M sampling episode, the Agency assumed filter backwash to be 1.2 percent of the influent flow to the chemical precipitation unit and that model sites discharged filtrate from this system to surface water or a POTW. Direct annual costs included O&M labor and energy costs. EPA incorporated waste disposal costs for solids at sites operating multimedia filters.

11.6.16 Microfiltration for Solids Removal

The Agency estimated costs for microfiltration for solids separation, assuming that flow rates of greater than the maximum costed system (406 gallons per minute) required multiple systems.

The module included capital and annual costs for the following equipment:

- Tubular membrane filtration modules;
- Carbon steel skid;
- Recirculation tank;
- Recirculation pump;
- Air back pulse system;
- Cleaning system;

- Sludge pump; and
- All associated instruments and controls.

EPA calculated the amount of sludge generated by this system using model-calculated site-specific influent pollutant concentrations for the commingled wastewater. Based on data collected during an MP&M sampling episode, the Agency assumed the sludge was 3.2 percent solids and was discharged to a sludge-thickening tank (see Section 11.6.17). EPA assumed model sites discharged microfiltration effluent to surface water or a POTW. Direct annual costs included O&M labor and materials (e.g., replacement membranes, cleaning chemicals) and energy costs.

11.6.17 Sludge Thickening

The Agency estimated costs for sludge thickening by gravity settling for the sludge discharged from slant-plate clarifiers and microfilters. EPA assumed the sludge-thickening system discharged 60 percent of influent flow as sludge, thus increasing the solids content of the sludge from 3 to 5 percent for clarifier sludges and from 3.2 to 5.3 percent for microfiltration sludges (6). EPA assumed that the model sites discharge thickened sludge to a pressure filter for further dewatering (see Section 11.6.18), and that they returned the remaining 40 percent of influent flow (supernatant) to the chemical precipitation system. The module included capital and annual costs for the following equipment:

- Sludge-thickening unit (package system); and
- Clarified water return pump.

Direct annual costs included O&M labor and energy costs.

11.6.18 Sludge Pressure Filtration

The Agency estimated costs for the plate-and-frame filter presses, estimating the number needed to increase the solids content of the sludge from approximately 5 to 35 percent (5). The module included capital and annual costs for the following equipment:

- Recessed plate or plate-and-frame filter press; and
- Two double-diaphragm sludge pumps.

Direct annual costs included O&M labor and sludge disposal costs. EPA assumed model sites contracted for off-site disposal of the denatured sludge (see Section 11.3.2 and Table 11-4). EPA also assumed these sites discharged the filtrate from this system to the chemical precipitation and sedimentation system.

11.7 References

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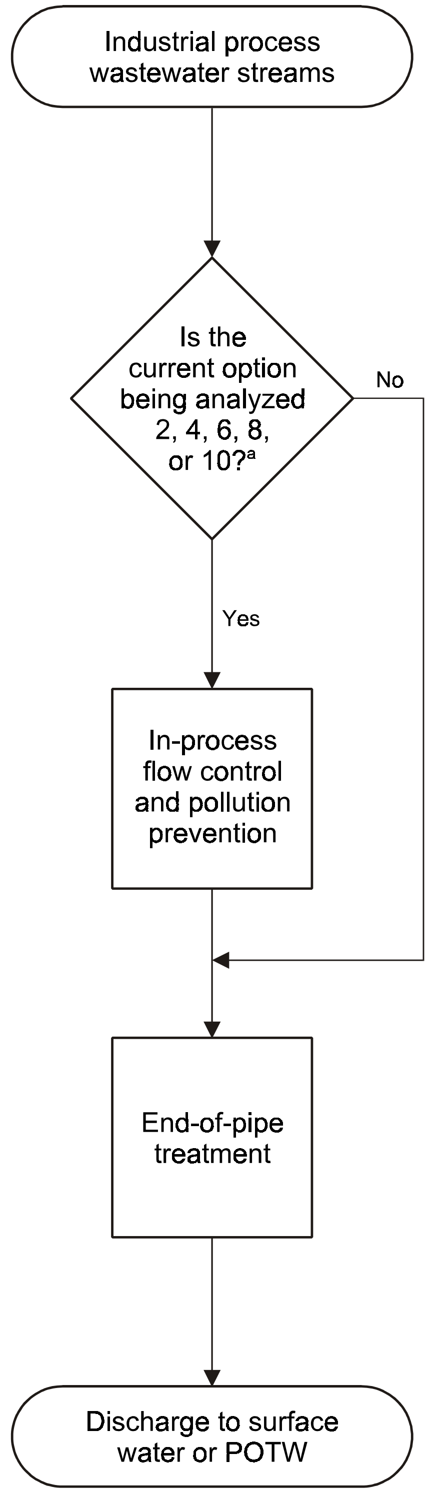


[a]See Section 9.0 for descriptions of the 10 technology options.

Figure 11-1. Relationship Between In-Process and End-of-Pipe Technologies and Practices

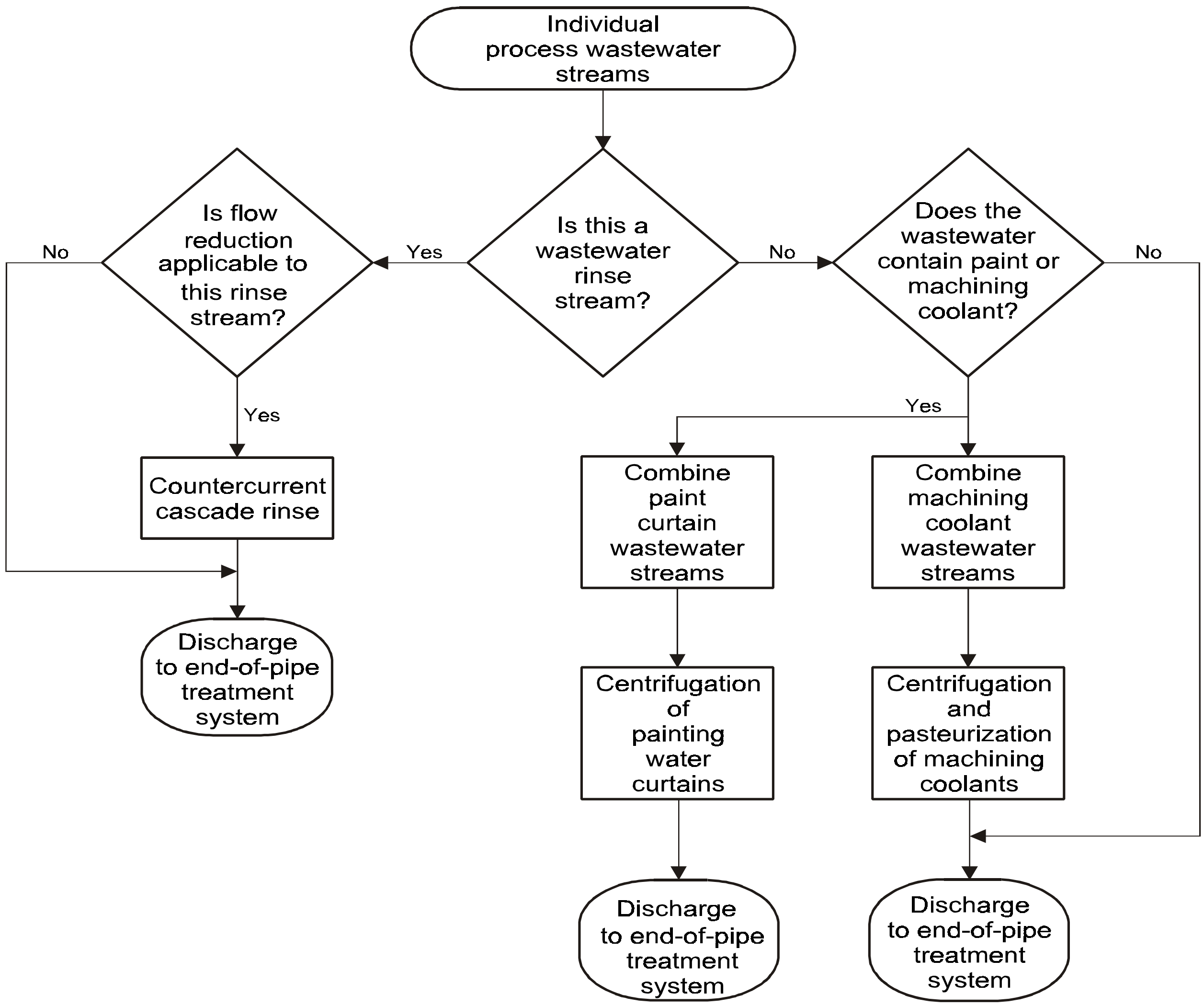


Figure 11.2. Components of Total Capital Investments

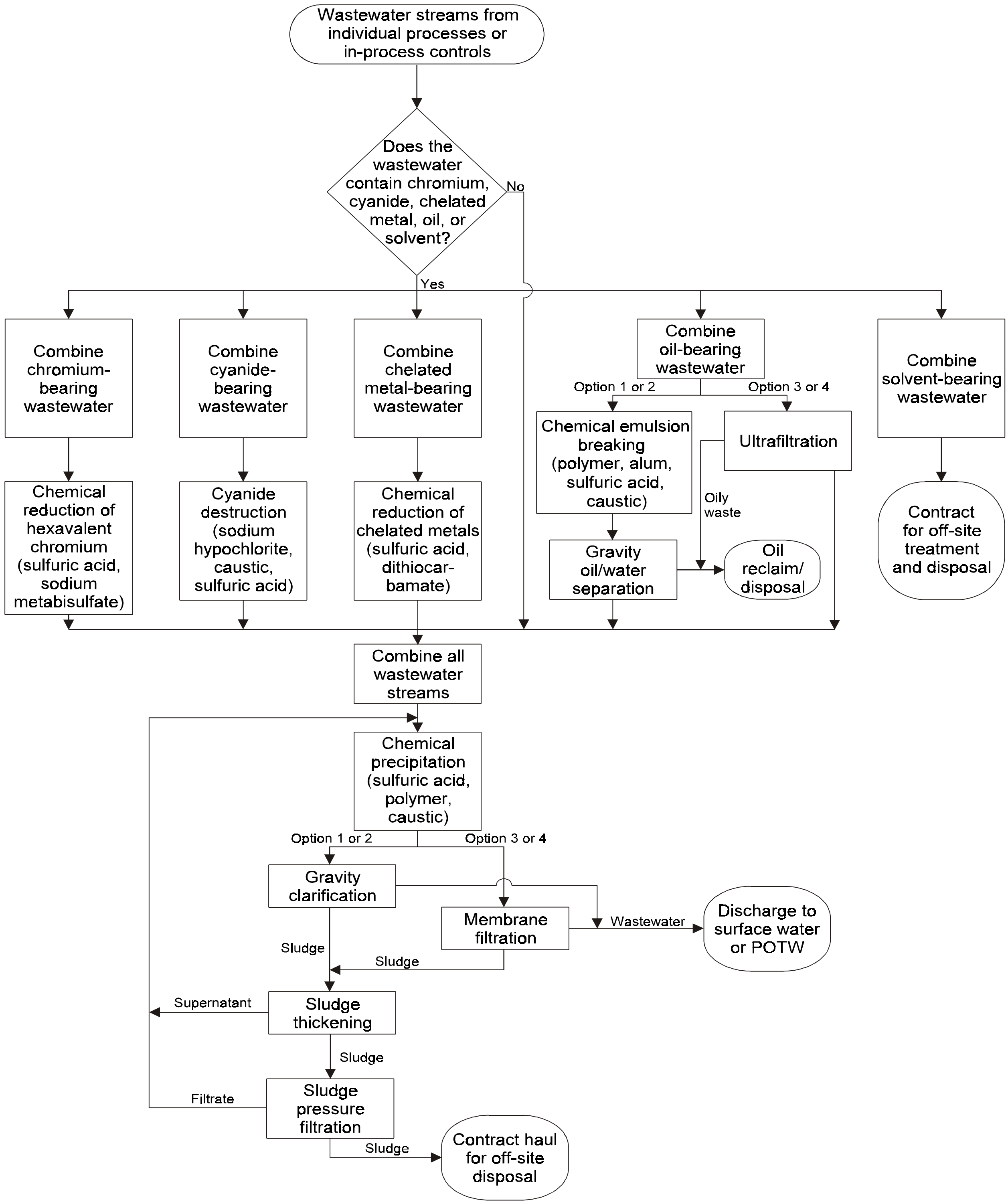
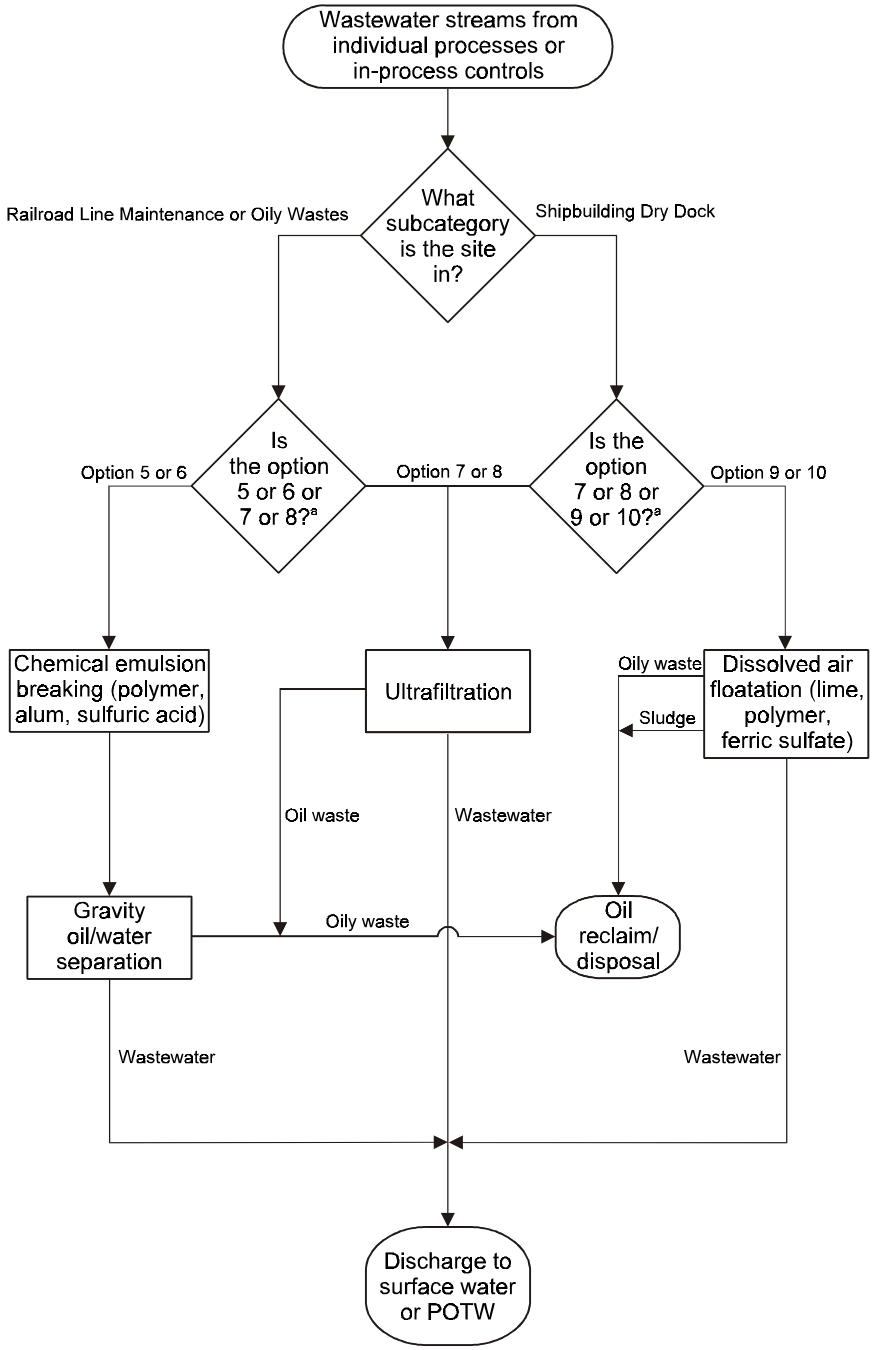


Figure 11-3. Logic Used to Apply End-of-Pipe Technologies and Practices for the Following Subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing



[a] See Section 9.0 for descriptions of the 10 technology options.

Figure 11-4. Logic Used to Apply End-of-Pipe Technologies and Practices for the Following Subcategories: Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock

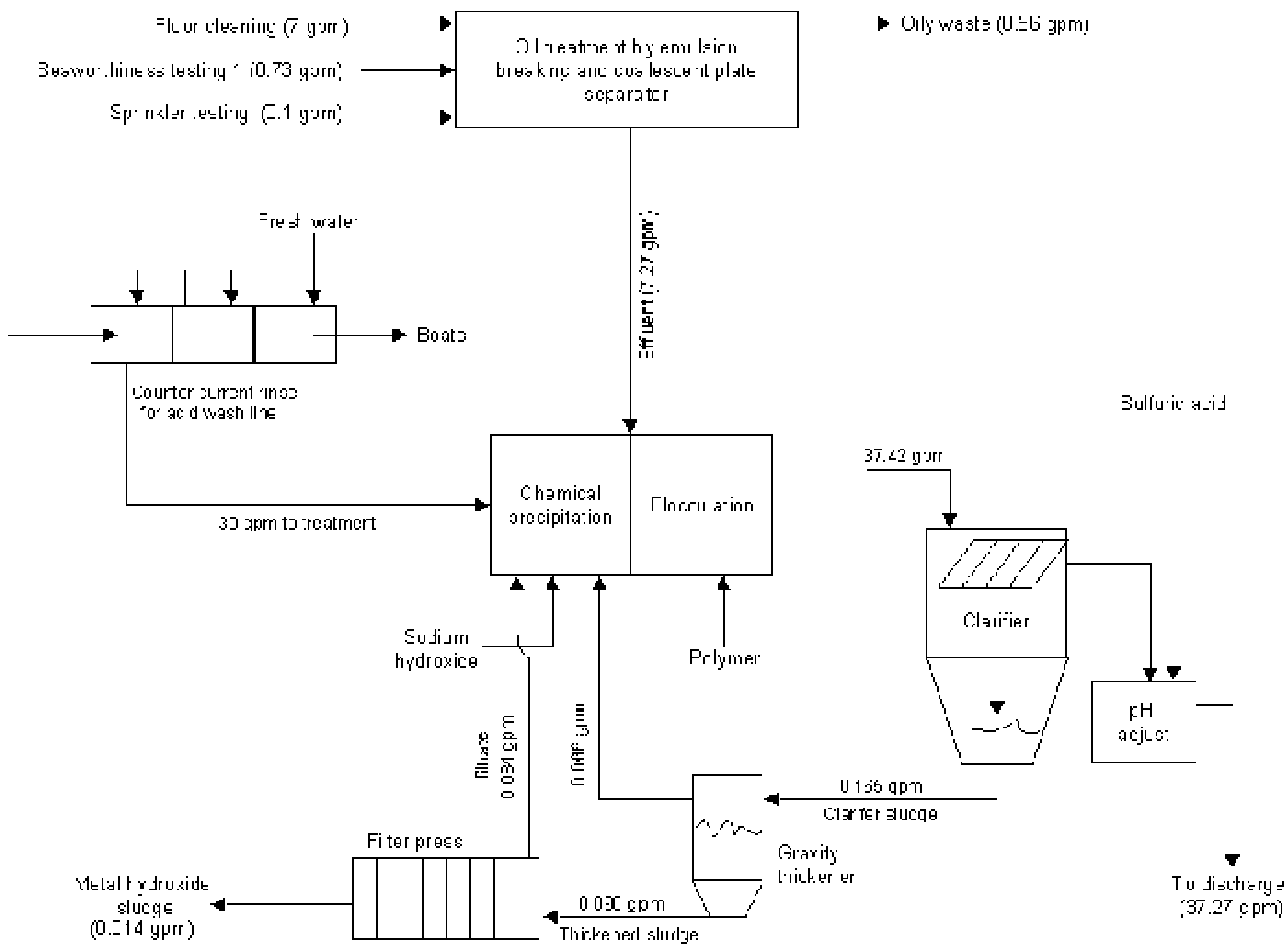


Figure 11-5. Example Treatment Facility for General Metals Subcategory Direct Discharger

12.0 POLLUTANT LOADING AND REDUCTION ESTIMATES

This section describes EPA's approach for modeling the MP&M industry annual pollutant loadings and removals for each technology option described in Section 9.0. In general, this approach consists of three major steps:

1. *Estimate baseline pollutant loading from each MP&M model site*. Wastewater discharged from MP&M unit operations goes to either on-site treatment, publicly owned treatment works (POTWs), or directly to surface waters. EPA used survey data from each model site to determine the destination of each waste stream. EPA estimated discharged pollutant concentrations from: EPA sampling data, industry-supplied data, and existing limitations. EPA estimated loadings by multiplying the discharged pollutant concentrations by the discharged flow. The baseline pollutant loading refers to the total amount of pollutants discharged from the model site to surface waters or POTWs for the base year of the survey.

2. *Estimate baseline pollutant loadings for the MP&M industry*. EPA multiplied the site-specific baseline wastewater loadings by the corresponding statistically derived weighting factors (see Section 3.0) for each model site. EPA summed the weighted loadings across all sites to estimate industry-wide baseline wastewater pollutant loadings.

3. *Estimate option-specific pollutant loadings and removals for the MP&M industry*. The option-specific pollutant loadings represent the total industry pollutant loadings in MP&M wastewater that would be discharged to surface water or POTWs after complying with a particular regulatory option.

Key terms for pollutant loadings and removals are defined below:

- Model sites - Facilities used in the EPA Costs & Loadings Model to represent the industry nationally. These facilities responded in the MP&M detailed survey that they discharge MP&M wastewater.

- Long-term average - Average pollutant concentrations achieved over a period of time by a facility, subcategory, or technology option.

- Baseline concentration - Pollutant concentration (milligrams per liter (mg/L)) in wastewater currently discharged to surface water or a POTW. If the facility has wastewater treatment in place, the baseline concentration is the pollutant concentration in wastewater discharged from final treatment. If the facility does not have treatment in place, the baseline concentration is the commingled concentration of all unit operation wastewater discharged.

- Baseline loadings - Modeled pollutant loadings, in pounds per year (lbs/yr), in MP&M wastewater currently being discharged to surface water or to POTWs for the base year of the model site's survey. These loadings reflect wastewater treatment in place at model sites in the year 1996.

- Option loadings - Also referred to as post-compliance loadings. Pollutant loadings, in lbs/yr, in MP&M wastewater that would be discharged to surface water or to POTWs after complying with a regulatory option. EPA calculated the loadings assuming that all MP&M facilities would achieve long-term average effluent pollutant concentrations associated with the technology options.

- Pollutant reductions - The difference between baseline loadings and option loadings for each regulatory option.

- Weighting factor - Statistically derived values for each model site used to reflect all facilities in the MP&M industry. (See Section 10.0, DCN 16118 of the rulemaking record). EPA multiplied the baseline or option loadings for each model site by its corresponding weighting factor to estimate industry-wide baseline or option loadings.

- Toxic pound-equivalents - Pollutant loadings, in pound-equivalents per year (PE/yr), in MP&M wastewater. A pound-equivalent (PE) is a pound of pollutant weighted for its toxicity to human and aquatic life.

Unless specified otherwise, EPA estimated baseline pollutant loadings and reductions for all pollutants identified in Section 7.0 as pollutants of concern. EPA used data from several sources to estimate pollutant loadings and reductions, including data from EPA sampling episodes, the existing 40 CFR 413 and 433 regulations, EPA's Permit Compliance System (PCS) database, pretreatment coordinators, states, and industry. See Section 3.0 for additional discussion on EPA's data collection efforts.

Note that all tables appear at the end of this section.

12.1 Estimation of Unit Operation Wastewater Pollutant Concentrations

EPA used sampling data and industry-supplied data (included in Sections 5.0 and 15.0 in the rulemaking record) to estimate subcategory-specific wastewater pollutant concentrations for each of the MP&M unit operations that generate wastewater at MP&M model sites.

12.1.1 Unit Operation Wastewater Data Collection

EPA's "unit operations database" comprises EPA sampling data and industry-supplied data. EPA collected unit operations wastewater discharged from 56 sites for 96 unit operations. Industry supplied EPA with wastewater data for 15 unit operations. Throughout this section, the terms “sampling point” and “sample” refer to the following:

- Sampling point - The physical location at which samples are collected. Example sampling points include a wastewater treatment influent stream, an electroplating bath, or a cleaning rinse. A sampling point captures the wastewater characteristics of a specific unit operation or a group of unit operations.

- Sample - The unique volume of wastewater collected for analysis at a sampling point. A sample can include several different aliquots collected for analysis of multiple parameters. Each sample represents a unique period of time. EPA typically collected multiple samples from sampling points that represented flowing waste streams (e.g., wastewater treatment systems, rinses).

12.1.2 Calculation of Pollutant Concentrations for Each Unit Operation for Each Sampling Point from EPA or Industry-Supplied Sampling Data

EPA collected both grab and composite samples to characterize MP&M unit operations. EPA generally collected grab samples for nonflowing streams where the pollutant concentrations were not expected to vary significantly over the sampling period. EPA generally collected composite samples (typically 24-hour composites) for flowing streams. For oil and grease, EPA collected a series of grab samples as specified by the analytical method. In some cases, EPA had to mathematically aggregate two or more samples to obtain a single value that could be used in calculations to represent a single waste stream. This occurred with field duplicates and grab samples collected over time. For each sample point, EPA aggregated field duplicates first, grab samples second, and multiple-day samples third. In cases where the sampled pollutants were not detected in the wastewater, EPA used the sample-specific detection limit as the pollutant concentration. EPA calculated pollutant concentrations for each sampling point using the following approach:

- *Average the duplicate sample concentrations.* As discussed in Section 3.0, EPA collected duplicate samples at many sampling points as a quality control measure. Industry-supplied data submitted with comments on the MP&M proposal also contained duplicate samples. Where duplicate samples were collected at a sampling point, EPA averaged the concentrations of the two samples to develop a single pollutant profile for the sampling point for that 24-hour period.

- *Average the grab sample aliquot concentrations*. EPA averaged the concentrations of all grab sample aliquot fractions (i.e., for oil and grease) collected during a 24-hour period in order to estimate a representative 24-hour composite for that parameter.

- *Average multiple sample concentrations for each sampling point.* For flowing wastewater streams (e.g., rinses), EPA and industry typically collected multiple samples at a single sample point to account for variability over time of the discharges from these streams. EPA averaged the concentrations of the composite or grab samples collected on each day at the same sampling point. For example, if EPA collected three one-day composite samples of an acid treatment rinse at the same sampling point, it averaged the concentrations of each pollutant on each of the three days to develop a single pollutant profile for the sampling point for that episode.

12.1.3 Estimation of Pollutant Concentrations for Each Subcategory and Unit Operation

EPA estimated pollutant concentrations for each unit operation performed in a given subcategory (as reported in the MP&M detailed surveys). For example, EPA estimated pollutant concentrations for UP-4 (acid treatment without chromium) separately for sites in the General Metals Subcategory and for sites in the Metal Finishing Job Shops Subcategory. For electroplating and electroless plating operations, EPA estimated the pollutant concentration(s) of the applied metal(s) separately from other bath constituents to account for the dependancy of these operations on high concentrations of the applied metal(s). EPA used the following steps to estimate the subcategory-specific unit operation wastewater pollutant concentrations at model MP&M sites:

1. Identified, for each subcategory, all unit operations reported in the detailed surveys (see Section 12.1.3.1);

2. Estimated pollutant concentrations for each unit operation in a given subcategory (see Section 12.1.3.2);

3. Estimated an applied metal concentration in the bath and in the rinse for each electroplating and electroless plating operation for each subcategory (see Section 12.1.3.3); and

4. Modeled pollutant concentrations for each model site unit operation (see Section 12.1.3.4).

These steps are described in the following subsections.

12.1.3.1 Identification of Unit Operations Reported in the Detailed Surveys

EPA queried the MP&M detailed survey database to identify all unit operations discharging wastewater, as well as all types of electroplating and electroless plating operations (defined by applied metal).

12.1.3.2 Estimation of Wastewater Pollutant Concentrations for Each Unit Operation/Subcategory Combination

For each subcategory, EPA calculated the average wastewater pollutant concentrations for each unit operation. For example, EPA averaged the wastewater pollutant concentrations for all acid cleaning operations (using the wastewater pollutant concentrations calculated at each sampling point) at facilities in the General Metals Subcategory. EPA also separately estimated wastewater pollutant concentrations for unit operations for the "zinc plater" segments of the Metal Finishing Job Shops and General Metals Subcategories.

Additionally, EPA combined the sampling data for all metal-bearing subcategories (with the exception of data from printed wiring board facilities[1]) and calculated the average wastewater pollutant concentrations for each unit operation. EPA did the same for all oil-bearing subcategories. EPA used the average unit operation concentrations calculated for metal-bearing subcategories and oil-bearing subcategories to estimate pollutant concentrations from unit operations in subcategories with no unit operation concentration data.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for the following pollutants:

- *Cyanide.* EPA set the cyanide pollutant concentration equal to zero for all non-cyanide-bearing unit operation wastewaters. (EPA sampling data included incidental cyanide concentrations for non-cyanide-bearing unit operations due to drag-out or unspecified sources.)

- *Total Sulfide.* EPA estimated wastewater pollutant concentrations for total sulfide using all results from Phase I and II sampling (Method 376.1) and an average of the results from Methods 376.2 and 4500-S2E from Phase III sampling. EPA used all three analytical methods (376.1, 376.2, and 4500-S2E) to measure total sulfide in Phase III sampling (i.e., post-proposal sampling); however, EPA did not use sampling data from Method 376.1 from Phase III due to possible interferences.

- *Oil and Grease.* EPA estimated wastewater pollutant concentrations for oil and grease using all Phase II and III data, but included Phase I data only in cases where no Phase II or III data were available for that unit operation in the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories. EPA used a different analytical method to measure for oil and grease during Phase I sampling than during Phase II and III sampling. EPA used Method 413.2 during Phase I sampling (a freon-extractable method). EPA used Method 1664 during Phase II and Phase III sampling (measures oil and grease as hexane extractable material).

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[1]EPA omitted data from the Printed Wiring Board Subcategory due to the high concentration of specific metals (i.e., copper) common to primarily the printed wiring board industry.

- *Sodium, Calcium, and Total Dissolved Solids.* EPA set the wastewater pollutant concentrations for these pollutants equal to zero for all unit operation wastewaters in all subcategories. EPA set the pollutant removals for sodium and calcium equal to zero in response to Phase I comments on the wide use of these two treatment chemicals, which results in elevated removals estimates. EPA set the loads removals for total dissolved solids (TDS) equal to zero because many treatment chemicals also elevate TDS concentrations.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for the following specific cases:

- *Testing.* EPA used data from radiator pressure testing operations to estimate unit operation wastewater pollutant concentrations for all testing unit operations at model sites in the oil-bearing wastewater subcategories and hydraulic testing unit operations in the metal-bearing wastewater subcategories. EPA used dye penetrant testing data to estimate wastewater pollutant concentrations in all other types of testing in the metal-bearing wastewater subcategories. EPA did not include the other EPA-sampled testing data (from alpha-case detection testing and engine performance testing coolant operations) based on the unique composition of wastewater for these site-specific operations.

- *Unit Operations with a Greater Rinse Concentration than Bath Concentration.* After averaging sampling data across samples for a particular sampling point, EPA found instances where the modeled bath had a lower concentration than for the same pollutant in the associated rinse. In these cases, EPA set the bath wastewater pollutant concentration equal to the rinse wastewater pollutant concentration.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for certain pollutants in the Non-Chromium Anodizing Subcategory:

- *Chromium, Hexavalent Chromium, Lead, and Cadmium.* EPA set the wastewater pollutant concentrations for these pollutants equal to zero for all unit operation wastewaters in the Non-Chromium Anodizing Subcategory. EPA defined the Non-Chromium Anodizing Subcategory as sites that have no chromium present in any operation on site. Therefore, EPA did not expect chromium or hexavalent chromium to be present at non-chromium anodizing facilities. EPA also did not expect lead or cadmium to be used in unit operations at non-chromium anodizing facilities based on the metal types processed by this subcategory.

For further details, refer to the memorandum entitled "MP&M Pollutant Loadings Methodology Changes from Proposal" located in the rulemaking record (Section 16.7, DCN 16764).

12.1.3.3 Estimation of Applied Metal Concentrations Using Available Analytical Data

While the pollutant concentrations in many MP&M unit operations are somewhat dependent on the type of metal processed, pollutant concentrations are heavily dependent on the applied metal in the electroplating and electroless plating operations. For example, chromium electroplating operations and rinses contain higher concentrations of chromium than other metals, while electroless nickel plating operations and rinses contain higher concentrations of nickel than other metals. EPA estimated the pollutant concentrations of the plated metal(s), referred to as "applied" metals, separately from other constituents in the bath and rinse to account for the dependency of the pollutant concentrations in these operations and rinses on these metal(s). When developing the model pollutant concentrations for these two unit operations, EPA designated the metal(s) applied to the surface of the product as the "applied metals" to distinguish them from other nonplated metals in the process bath. EPA also designated these metals that wash off the product during the process rinse as the "applied metals" in the rinse.

To more adequately represent the metals concentrations in the wastewater from electroplating and electroless plating operations, EPA used a different approach for applied metals and other plating bath constituents in these operations. Due to budget constraints, EPA did not obtain sampling data for every type of plating solution and rinse reported in the detailed surveys and was therefore unable to estimate separately the pollutant concentrations for each type of plating. EPA modeled the pollutant concentrations in electroplating and electroless plating solutions using the following approach:

1. EPA calculated the total applied metal concentrations for each plating bath for which EPA had collected data. If a sampling point had two applied metals (e.g., zinc and cobalt), the two pollutant concentrations were summed to get a total applied metal concentration. If a sampling point had one applied metal, the concentration for that metal was the total applied metal concentration.

2. For each subcategory, EPA calculated the median total applied metal concentration for all plating baths for which EPA had sampling data. EPA calculated these median concentrations separately for electroplating and electroless plating baths. EPA then modeled the total metal concentration in the bath at the model site as the median concentration of total metals for which EPA had data. Note that the Agency had sufficient data to estimate the total applied metal concentration on a subcategory-specific basis, but not on a pollutant-specific basis. For subcategories with no available applied metal data, EPA used the median of all total applied metal concentration data across all subcategories.

3. EPA calculated the average concentration for all nonapplied pollutants across the plating baths (separating electroplating from electroless plating baths). For example, EPA calculated the cadmium concentration in all baths other than cadmium electroplating baths. EPA then modeled the concentration of the nonapplied pollutants as the average concentration for the pollutant across the plating baths.

EPA followed the same approach for estimating pollutant concentrations in electroplating and electroless plating unit operation rinses. For further detail, refer to the memorandum entitled "MP&M Pollutant Loadings Data Transfer for Base/Applied Metals" located in the rulemaking record (Section 16.7, DCN 16763).

12.1.3.4 Modeling of Pollutant Concentrations for Each Model Site Unit Operation

To estimate the pollutant concentrations for each model site unit operation, EPA first identified the unit operations performed by the model sites in each subcategory. For unit operations for which it had collected pollutant concentration data, EPA modeled the wastewater pollutant concentrations using the corresponding unit operation average wastewater pollutant concentrations calculated from sampling data for that unit operation in the same subcategory. For example, EPA calculated the average concentrations for all pollutants of concern identified in alkaline cleaning operations in the General Metals Subcategory, and applied these average concentrations to all alkaline cleaning operations reported in the surveys for this subcategory.

When EPA did not have pollutant concentration data for a unit operation within a subcategory, EPA transferred pollutant concentrations from unit operations expected to have similar wastewater characteristics, based on process considerations. Process considerations include the following: the purpose of the unit operation (e.g., metal removal, contaminant removal); the purpose of the process water use (e.g., contact cooling water, cleaning solution, rinse water); and typical bath additives (e.g., acids, organic solvents, metal salts). EPA transferred available pollutant concentration data to the model sites using the following hierarchy:

1. If EPA sampled the same unit operation bath (or rinse) at facilities in more than one subcategory, including the same subcategory as the model site, the Agency used available analytical data for the same operation in the same subcategory to estimate wastewater pollutant concentrations for the model site unit operation. For example, if available analytical data for a unit operation exist for both the General Metals and the Metal Finishing Job Shops Subcategories, EPA transferred data from only the General Metals Subcategory to model the wastewater pollutant concentrations for the same unit operation at a model site in the General Metals Subcategory.

2. If EPA sampled the same unit operation bath (or rinse) at facilities in only one MP&M subcategory, even if it is a different subcategory than that of the model site, the Agency transferred these data to the same unit

operation bath (or rinse) at model sites. For example, if available analytical data for a unit operation exist only for the General Metals Subcategory, EPA transferred these data to model the wastewater pollutant concentrations for the same unit operation at a model site in any other subcategory.

3. If EPA did not have unit operation sampling data from a site in Subcategory A, then EPA used unit operation sampling data from a site in a similar subcategory (e.g., if Subcategory A is a metal-bearing subcategory, data from another metal-bearing subcategory was used). The Agency used available analytical data for the same operation in similar subcategories to estimate wastewater pollutant concentrations for the model site unit operation. For example, if available analytical data for a unit operation bath (or rinse) exist from both metal-bearing wastewater facilities and oil-bearing wastewater facilities, EPA used the following approach. If the model site is designated as one of the metal-bearing wastewater subcategories, only available analytical data from other metal-bearing wastewater subcategorized facilities were used to estimate wastewater pollutant concentrations. EPA used the same approach for oil-bearing wastewater subcategories.

4. If EPA did not sample a unit operation bath (or rinse) that is the same as the unit operation at a model site, the Agency used the available analytical data for a unit operation bath (or rinse) that has similar wastewater characteristics, but are within the same subcategory, to estimate wastewater pollutant concentrations for the model site unit operation. Due to budget constraints, EPA did not collect data for 22 baths and 24 rinses, representing approximately 8.3 percent of the total MP&M discharge flow rate. The basis for these estimates are discussed in the memorandum entitled “Data Transfers Between Unit Operations” located in the rulemaking record (Section 16.7, DCN 17767).

Supporting documentation for all data transfers of unit operation pollutant concentrations is contained in Section 16.7 of the MP&M rulemaking record.

12.2 Estimation of Industry Baseline Pollutant Loadings

Industry baseline wastewater pollutant loadings are modeled pollutant loadings in MP&M wastewater discharged to surface waters or to POTWs for the base year of the detailed surveys, supplemented by additional site information provided to EPA. These loadings reflect wastewater treatment in place at model sites in the year 1996. EPA estimated baseline pollutant loadings using the effluent pollutant concentrations, unit operation flows provided in the questionnaire (as described in Section 11.2.2), and effluent flows from treatment (estimated by the EPA Costs & Loadings Model as described in Section 11.3.3). EPA estimated the baseline pollutant loadings using the approaches described in this subsection.

12.2.1 Estimation of Baseline Pollutant Concentrations from Sites in the Metal-Bearing Subcategories

For the final rule, EPA revised its methodology for estimating baseline pollutant concentrations in metal-bearing subcategories. The final methodology varies depending on whether or not the stream is treated or untreated and also by its current regulatory status.

12.2.1.1 Estimation of Effluent Pollutant Concentrations for Untreated Streams

EPA used the following steps to estimate the wastewater pollutant concentrations for each pollutant of concern (POC) in wastewater discharged from model sites without treatment:

1. *Estimated wastewater pollutant concentrations for each unit operation that discharges wastewater from the site without treatment.* EPA estimated unit operation wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that the unit operations data were significantly revised between the proposal and the Notice of Data Availability (NODA), and have been revised further based on comments on the NODA (see DCN 16764 in Section 16.7 of the rulemaking record).

2. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 413 only (Baseline for the 413 to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and complying with Part 413. For streams not currently receiving treatment at model sites subject to Part 413, but not Part 433, EPA assumed the sites achieved the monthly average limitation for Part 413 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the Part 413 limits (as opposed to achieving the long-term average (LTA) concentration)). EPA noted that the Part 413 limit for cyanide is different for small platers than for large platers. For parameters not regulated by Part 413, EPA estimated wastewater pollutant concentrations from the unit operations data. MP&M facilities covered under Part 413 only include some, but not all, indirect dischargers in the Printed Wiring Board, Metal Finishing Job Shops, and General Metals Subcategories. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities regulated under Part 413 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of untreated streams for this analysis.

3. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 433 (or Parts 413 and 433).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and

complying with 40 CFR 413 and 433, or 433 only. EPA assumed the untreated streams achieved the monthly average limitation for Part 433 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the Part 433 limits (as opposed to achieving the LTA concentration)). For parameters not regulated by Part 433, EPA estimated wastewater pollutant concentrations from the unit operations data. MP&M facilities covered under Part 433 include all direct and some indirect dischargers in the Printed Wiring Board and Metal Finishing Job Shops Subcategories, and some direct and indirect dischargers in the General Metals and Non-Chromium Anodizing Subcategories.

4. *Incorporated limits on wastewater discharged from sites not regulated by 40 CFR 413 or 433 (Baseline for the Local Limits to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA also incorporated changes to take into account the compliance of indirect dischargers in the General Metals Subcategory, not currently regulated by Parts 413 or 433, with local limits. Although EPA could not obtain actual local limits for all facilities, EPA gathered local limits data from 213 POTWs in seven EPA Regions to develop national median local limit values. (see DCN 17844 of the rulemaking record for a list of the data and the median value for each parameter). EPA assumed the untreated streams achieved the national median local limit for all parameters regulated by Part 433 in untreated streams. For parameters not regulated by Part 433, EPA estimated wastewater pollutant concentrations from the unit operations data. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities not regulated under Parts 413 or 433 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of untreated streams for this analysis.

5. *Estimated commingled wastewater concentrations for all untreated streams.* EPA combined the wastewater from all unit operation discharges that are not sent through treatment. EPA calculated the commingled concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream.

12.2.1.2 Estimation of Effluent Pollutant Concentrations for Treated Streams

EPA used the Costs & Loadings Model (see Section 11.0) to estimate the pollutant concentrations in wastewater discharged from the treatment technology at each model site. EPA used the following steps to estimate the wastewater pollutant concentrations for each POC in treated discharged wastewater:

1. *Estimated wastewater pollutant concentrations for each unit operation that discharges wastewater to treatment.* EPA estimated unit operation

wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that the unit operations data were significantly revised between the proposal and the NODA, and have been revised further based on comments on the NODA (see DCN 16764 in Section 16.7 of the rulemaking record).

2. *Estimated wastewater concentrations in influent to treatment (commingled wastewater concentrations for all treated streams).* EPA combined the wastewater from all unit operations that discharge to treatment. EPA calculated the commingled (treatment influent) concentration of each POC in the combined MP&M wastewater, based on pollutant concentrations and flow rates of each stream. The treatment influent concentrations are required to estimate baseline costs (see Section 11.0).

3. *Estimated wastewater concentrations in effluent from treatment.* EPA used the Costs & Loadings Model (see Section 11.0) to estimate the pollutant concentrations in wastewater discharged from each model site wastewater treatment unit. The following summarizes the pollutant concentrations for the various treatment technologies reported for the metal-bearing subcategories.

    - *Treatment Equivalent to the Metal Finishing (40 CFR 433) Best Available Treatment (BAT).* EPA assumed that all streams that undergo treatment equivalent[2] to the Metal Finishing (40 CFR 433) BAT technology basis are treated to achieve the LTAs promulgated at 40 CFR 433 for those parameters regulated under Part 433 (433 parameters). EPA assumed that parameters not regulated under Part 433 (non-433 parameters) are treated to achieve the LTAs based on MP&M BAT (Option 2) sampled sites.

    - *Microfiltration for Solids Removal Technology*. For streams treated by a membrane system, EPA assumed that the membrane technology could treat to a lower concentration than the 433 LTAs. Therefore, EPA assumed the membrane technology could achieve the lower of the LTAs calculated based on MP&M sampled sites using membrane technology or the 433 LTAs.

    - *Chemical Reduction of Chelated Metals.* For streams treated by a chelation breaking system, EPA assumed the reduction of chelated metals to the elemental state. The concentrations of carbon disulfide and dithiocarbamate (DTC) increase in the chelation breaking module to account for addition of treatment chemicals.

[2]Refer to Table 11-5 for treatment technologies considered equivalent to chemical precipitation and sedimentation.

- *Oil Treatment (Chemical Emulsion Breaking and Oil/Water Separation) and Batch Oil Emulsion Breaking with Gravity Flotation.* EPA assumed oil treatment and batch oil emulsion breaking technologies could achieve the LTAs calculated based on MP&M sampled sites using chemical emulsion breaking with gravity oil/water separation.

- *Ultrafiltration (for Oil Removal).* EPA assumed ultrafiltration technologies could achieve the LTAs calculated based on MP&M sampled sites using ultrafiltration (for oil removal).

- *Dissolved Air Flotation (DAF).* EPA assumed DAF technology could achieve the 433 limits for all 433 parameters. For non-433 parameters, EPA assumed DAF technology could achieve the LTAs calculated based on MP&M sampled sites using DAF technology.

- *Cyanide Destruction and Ion Exchange.* EPA assumed cyanide destruction and ion exchange technologies could reduce the amount of cyanide in cyanide-bearing wastewater. EPA assumed total cyanide, amenable cyanide, and weak-acid dissociable cyanide are reduced to the LTAs calculated based on MP&M sampled sites using cyanide destruction. The concentration of chloroform increases in the cyanide destruction module to account for the reduction process.

- *Chemical Reduction of Hexavalent Chromium.* EPA assumed hexavalent chromium reduction could reduce the amount of hexavalent chromium to achieve the LTA calculated based on MP&M sampled sites using hexavalent chromium reduction. The concentration of trivalent chromium increases in the hexavalent chromium reduction module to account for the conversion process.

Note that if the treated effluent concentration for a pollutant was more than its corresponding treatment influent concentration (obtained in step 2 above), EPA retained the treatment influent concentration to estimate the baseline concentration for that pollutant.

4. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 413 only (Baseline for the 413 to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and complying with Part 413 only. For streams receiving treatment at model sites subject to Part 413, but not Part 433, EPA assumed the sites achieved the LTAs for Part 413 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the

Part 413 LTA concentration). EPA noted that 40 CFR 413 only sets limitations on lead, cadmium, and cyanide for small platers. EPA assumed small platers achieved the monthly limit average for those additional parameters regulated by Part 413 for large platers. For parameters not regulated by Part 413, EPA assumed sites achieve the baseline pollutant concentrations for the treatment technology. MP&M facilities covered under Part 413 only include some indirect dischargers in the Printed Wiring Board, Metal Finishing Job Shops, and General Metals Subcategories. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities regulated under Part 413 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of treated streams for this analysis.

5. *Incorporated limits on wastewater discharged from sites not regulated by 40 CFR 413 or 433 (Baseline for the Local Limits to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA also incorporated changes to take into account the compliance of indirect dischargers in the General Metals Subcategory, not currently regulated by Parts 413 or 433, with local limits. Although EPA could not obtain actual local limits for all facilities, EPA gathered local limits data from 213 POTWs in seven EPA Regions to develop national median local limit values. (see DCN 17844 of the rulemaking record for a list of the data and the median value for each parameter). EPA assumed the treated streams achieved one-half of the national median local limit values[3] for all parameters regulated by Part 433. For parameters not regulated by Part 433, EPA assumed the treated streams achieved the national median local limit values. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities not regulated under Parts 413 or 433 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of treated streams for this analysis.

12.2.1.3 Estimation of Commingled Effluent Pollutant Concentrations from Sites

EPA combined the wastewater from treated and untreated streams. EPA calculated the commingled baseline effluent pollutant concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream (treated and untreated).

EPA received comments that, although the concentration of chemical oxygen demand (COD) in discharged wastewater is not regulated by Parts 413 or 433 (unlike oil and

[3]EPA used ½ the median value to take into account that facilities do not operate treatment systems to achieve the limit, but some value below the limit to account for variability.

grease and total suspended solids), it is typically regulated by local limits. EPA reviewed data from the Permit Compliance System (PCS) and found that, while COD is not generally regulated by local limitations, a small number of facilities do have COD restrictions. EPA found similar results for total kjeldahl nitrogen (TKN) and ammonia as nitrogen (NH)[4]. Since EPA could not identify which sites in PCS may have been subject to MP&M, EPA conducted its analysis using information from process wastewater dischargers from facilities in the 3000 series SIC codes. Using information from those sites with COD, TKN, and NH limitations, EPA calculated a single local limit value for each parameter. These values are 175, 35.67, and 19.3 mg/L for COD, TKN, and NH, respectively. EPA compared the baseline pollutant concentrations it predicted for these pollutants at each site. If these concentrations were in excess of the local limit value, then EPA set the concentration for the commingled MP&M wastewater discharged from each model site in metal-bearing wastewater subcategories equal to the local limit value. Details are provided in the memorandum "Loadings Methodology for Cost Model Run 4" (DCN 17846 in Section 24.7 of the rulemaking record).

12.2.2 Estimation of Baseline Pollutant Concentrations from Sites in the Oil-Bearing Subcategories

For the proposal and the NODA, EPA's methodology to estimate baseline pollutant concentrations for facilities in oil-bearing wastewater subcategories was similar to the one used at that time for metal-bearing wastewater subcategories. EPA received comment on the proposal and NODA that this methodology overestimated baseline pollutant concentrations for Shipbuilding Dry Dock, Railroad Line Maintenance, and Oily Waste sites. In response to these comments, EPA significantly revised its methodology for estimating baseline pollutant concentrations in the oil-bearing wastewater subcategories. Because EPA has different types of information in its database for each oil-bearing wastewater subcategory, it used different methods to represent baseline pollutant concentrations for each oil-bearing wastewater subcategory. The final methodologies used for each oil-bearing wastewater subcategory are described individually below.

12.2.2.1 Estimation of Baseline Pollutant Concentrations from Sites in the Shipbuilding Dry Dock Subcategory

For the final rule, EPA used its sampling data and industry supplied long-term monitoring data to estimate baseline pollutant concentrations for this subcategory. This data includes pollutant concentrations measured at two EPA sampling episodes and those reported in three years of Detailed Monitoring Reports (DMR) covering numerous dry dock discharges from a single shipbuilding dry dock facility. In estimating baseline pollutant concentrations in this manner, EPA looked at the individual data points as well as averages for its conclusions. See DCNs 17859 and 17860 in Sections 24.6.1 and 24.5.1 of the final rulemaking record for additional information. Note that for the final rule, EPA only estimated baseline concentrations for total suspended solids (TSS) and oil and grease because EPA had previously determined that

[4]EPA reviewed these parameters because they were important in estimating benefits (see the Economic, Environmental, and Benefits Analysis for the Final MP&M Rule (EEBA)).

discharges from these facilities contain minimal concentrations of toxic organic and metal pollutants.

12.2.2.2 Estimation of Baseline Pollutant Concentrations from Sites in the Railroad Line Maintenance Subcategory

In response to proposal and NODA comments, EPA revisited its database of direct discharging Railroad Line Maintenance facilities. EPA found that many of the facilities in its database would not be subject to this rule because they discharged only noncontaminated stormwater or wastewater resulting from refueling operations (neither of which is subject to the final rule). As a result of this review, EPA concluded its database was insufficient to make any regulatory decisions on direct discharging Railroad Line Maintenance facilities.

However, as part of its comments on the proposed rule and as discussed more fully in the NODA (67 FR 38755), the American Association of Railroads (AAR) provided a census listing of each Railroad Line Maintenance direct discharging facility known to them. For each facility, AAR provided a description of treatment technologies, a summary of effluent data, including flow rates, permit limits, and a process flow diagram or description of the operations. For the final rule, EPA used this information to create a new database representing direct discharging Railroad Line Maintenance facilities.

EPA's final database consists of nine direct discharging Railroad Line Maintenance facilities. Six of the nine facilities use technologies consistent with the Option 6 technology basis, two use technologies consistent with the Option 10 technology basis, and one uses biological treatment.

For the final rule, EPA did not need to model effluent pollutant concentrations for each of the final database facilities. Rather, EPA used the summary effluent data provided for each facility to represent baseline oil and grease and TSS concentrations in the Railroad Line Maintenance Subcategory. For additional information, see DCN 17861 in Section 24.6.1 of the rulemaking record. Note that EPA considered only TSS and oil and grease because it had previously determined that discharges in this subcategory contain few pounds of toxic pollutants.

12.2.2.3 Estimation of Baseline Pollutant Concentrations from Sites in the Oily Wastes Subcategory

For the final rule, EPA estimated baseline pollutant concentrations using a different methodology for treated and untreated streams in the oily waste subcategory.

Treated Streams: Where EPA had survey information (DMR data) for a particular site with treatment, EPA used that information as the baseline pollutant concentration. For half of the oily waste subcategory facilities with treatment, however, EPA had to estimate baseline pollutant concentrations. In all of these cases, EPA determined the treatment currently in place would achieve equivalent or greater removals to the treatment technology considered as the technology basis for limitations in this subcategory (Option 6). Therefore, where EPA did not have DMR data for a facility with treatment in place, EPA estimated its baseline pollutant concentrations as the median effluent concentrations of the DMR data from facilities with the option 6 technology.

Untreated Streams: EPA had DMR data for one site that indicated no treatment. Therefore, EPA used this data as the baseline pollutant concentrations for this facility. For the remaining sites without treatment, EPA had to estimate baseline pollutant concentrations. For these sites, EPA estimated unit operation wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that it significantly revised the unit operations data between the proposal and the NODA, and between the NODA and final rule based on comments on the NODA (see DCN 16764, in Section 16.7 of the rulemaking record). EPA combined the wastewater from all unit operation discharges that are not sent through treatment. EPA calculated the commingled concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream.

12.2.3 Estimation of Model Site Baseline Loadings

EPA estimated the pollutant loadings (lbs/yr) in effluent wastewater (treated or untreated) discharged from each MP&M model site. EPA estimated pollutant-specific baseline loadings by multiplying the effluent pollutant concentration of the pollutant by the corresponding effluent wastewater flow rate. To determine site-specific pollutant baseline loadings for sites that have both treated and untreated streams, EPA summed the estimated pollutant-specific baseline loading from the untreated effluent and the treated effluent. EPA estimated site-specific baseline loadings by summing site-specific pollutant baseline loadings for all pollutants considered.

For direct dischargers in the General Metals Subcategory, EPA additionally compared the baseline pollutant loadings from EPA’s Costs & Loadings Model to available DMR data. EPA obtained DMR data for 18 of the model sites. The MP&M model did not overestimate baseline loadings for 12 of these 18 model direct discharging facilities (or approximately two-thirds of these facilities). The relative percent difference (in pound-equivalents) of the model baseline loadings and those estimated using DMR data is 14 percent. Based on this analysis, EPA concluded that the MP&M model estimates of baseline pollutant loadings are reasonable and appropriate.

12.2.4 Estimation of Industry-Wide Baseline Pollutant Loadings

EPA multiplied the site-specific baseline wastewater loadings by the corresponding statistically derived weighting factors (see Section 3.0) for each model site. EPA summed the weighted loadings across all sites in each subcategory to estimate subcategory-specific baseline wastewater pollutant loadings. EPA also summed the weighted loadings across all sites to estimate industry-wide baseline wastewater pollutant loadings. Table 12-2 presents the estimated baseline pollutant loadings by subcategory for direct and indirect dischargers.

12.3 Estimation of Industry Option Pollutant Loadings

Industry option pollutant loadings (i.e., post-compliance pollutant loadings for the technology option) represent the total loadings of pollutants in all MP&M wastewater that would be discharged to surface waters or POTWs after complying with the regulatory option. The estimation of industry option pollutant loadings for each subcategory is described in the following subsections.

12.3.1 Estimation of Industry Option Pollutant Loadings for Sites in the Metal-Bearing Subcategories

Direct Dischargers (General Metals Subcategory). EPA estimated option effluent concentrations assuming that all direct discharging MP&M facilities in the General Metals Subcategory would achieve long-term average effluent pollutant concentrations associated with the MP&M sampled sites performing BAT (Option 2, including chemical precipitation with clarification). EPA estimated effluent concentrations for all pollutants of concern (listed in Section 7.0). Note that if the long-term average effluent concentration for a pollutant was more than its corresponding treatment influent concentration (based on unit operation wastewater concentrations), EPA retained the treatment influent concentration to estimate the option effluent concentration for that pollutant.

Indirect Dischargers - 413 to 433 Upgrade Analysis for sites regulated by 40 CFR 413 only (General Metals, Printed Wiring Board, and Metal Finishing Job Shop Subcategories). EPA estimated option effluent concentrations assuming all indirect discharging MP&M facilities in metal-bearing subcategories, currently regulated by 40 CFR 413 only, would achieve long-term average effluent pollutant concentrations associated with the BAT sites sampled under development of 40 CFR 433 (at the option). EPA estimated effluent concentrations only for pollutants regulated under 40 CFR 433.

Indirect Dischargers - Local Limits to 433 Upgrade Analysis for sites regulated by local limits (General Metals Subcategory). EPA estimated option effluent concentrations assuming all indirect discharging facilities in the General Metals Subcategory, not currently regulated by 40 CFR 413 or 433, would achieve long-term average effluent pollutant concentrations associated with the BAT sites sampled under development of 40 CFR 433 (at the option). For pollutants regulated under local limits, but not regulated under Part 433, EPA assumed the facilities would achieve the national median local limit values. EPA estimated effluent concentrations only for pollutants regulated under local limits.

EPA then estimated post-compliance pollutant loadings for each model facility by multiplying the treated effluent concentration by its wastewater flow rate to obtain a mass loading (in pounds) for each pollutant. Finally, EPA estimated site-specific option loadings.

EPA summed the mass loadings for all pollutants in the final effluent discharged from the model site.

12.3.2 Estimation of Industry Option Pollutant Loadings for Sites in the Shipbuilding Dry Dock Subcategory

Because EPA concluded that national regulation of discharges from the Shipbuilding Dry Dock Subcategory is unwarranted[5], EPA did not assess option pollutant loadings for this subcategory.

12.3.3 Estimation of Industry Option Pollutant Loadings for Sites in the Railroad Line Maintenance Subcategory

For this subcategory, EPA used information in its database on current permit limitations for facilities operating the Option 6 technology to estimate post-compliance pollutant loadings. All of the facilities that operate the Option 6 technology have a daily maximum oil and grease limit of 15 mg/L. For TSS, half of the facilities have a daily maximum limit of 45 mg/L while the other half have no limit. Based on this information, the oil and grease and TSS daily maximum limits representing the average of the best performing Option 6 facilities would be 15 mg/L and 45 mg/L, respectively. To estimate pollutant loadings for each model facility, EPA multiplied these maximum limits by the wastewater flow (provided in the survey) to obtain a mass loading (in pounds) for TSS.

12.3.4 Estimation of Industry Option Pollutant Loadings for Sites in the Oily Wastes Subcategory

EPA calculated the loadings assuming that all Oily Wastes sites would achieve long-term average effluent pollutant concentrations associated with the MP&M sampled sites performing BAT (Option 6, including chemical emulsion breaking with gravity oil/water separation).

First, EPA estimated the pollutant concentrations in the effluent from treatment at each model site, using the LTAs calculated from MP&M BAT sampled sites. The calculated LTAs for oil and grease and TSS are 18.89 mg/L and 44 mg/L, respectively. Note that if the long-term average effluent concentration for a pollutant was more than its corresponding treatment influent concentration (based on unit operation wastewater concentrations), EPA retained the treatment influent concentration to estimate the option concentration for that pollutant.

Second, EPA estimated site-specific pollutant loadings. EPA multiplied the pollutant concentrations in the final effluent (discharged from the model site) by the wastewater

[5]See Section VI.H of the final preamble for additional discussion.

flow rate (calculated in the EPA Costs & Loadings Model, or provided in the DMR) to obtain a mass loading (in pounds) for each pollutant.

Finally, EPA estimated site-specific option loadings. EPA summed the mass loadings for all pollutants in the final effluent discharged from the model site.

12.4 Estimation of Pollutant Reductions

Option pollutant reductions represent the incremental amount of pollutants removed by each technology option with respect to EPA's estimated baseline pollutant loadings. EPA estimated baseline pollutant loadings as explained in Section 12.2. EPA estimated option pollutant loadings as explained in Section 12.3. EPA estimated pollutant reductions as follows:

1. *Estimated site-specific, pollutant-specific option removals.* EPA calculated the difference between the model site's baseline pollutant loadings and option pollutant loadings. For direct dischargers, EPA considered all pollutants of concern, with the exception of boron, sodium, calcium, and total dissolved solids. For indirect dischargers, EPA considered only pollutants regulated under 40 CFR 433. EPA further reduced the model site's option-specific pollutant removals for indirect dischargers by their corresponding POTW percent removal (listed in Table 12-1) to account for treatment that will occur at the POTW. A detailed discussion of how EPA developed pollutant-specific POTW percent removals is provided in Section 7.3.1 of the <u>Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products and Machinery Point Source Category</u>.

2. *Modified site-specific, pollutant-specific option removals.* First, if the option-specific concentration for certain pollutant(s) was greater than the estimated baseline concentration for a model site, EPA set option-specific loadings for the pollutant(s) equal to the baseline loadings at those sites (EPA set the option-specific pollutant removal for that model site equal to zero). This was the case if the pollutant long-term average concentration for the treatment currently in place at the site was lower than that for EPA's treatment technology option (i.e., a model facility uses membrane technology, but EPA's option technology is chemical precipitation). Second, EPA set all removals of boron equal to zero. EPA determined that boron is not removed by most of the selected option treatment technologies, as discussed in the NODA. For additional details, refer to the memorandum entitled "Treatment System Removal of Boron from MP&M Wastewaters" in Section 16.7, DCN 16758 of the rulemaking record.

3. *Estimated toxic site-specific, pollutant-specific option removals.* EPA also calculated the site-specific, pollutant specific removals in toxic

pound-equivalents. A pound-equivalent (PE) is a pound of pollutant weighted for its toxicity to human and aquatic life. EPA multiplied the site-specific option pollutant removals (in pounds) by the corresponding toxic-weighting factor (TWF).

4. *Estimated site-specific option removals.* EPA summed the pollutant removals for all pollutants at the model site.

5. *Estimated industry-wide option loadings and removals.* For each option, EPA multiplied the site-specific option loadings and removals (accounting for POTW removals for indirect dischargers) by the corresponding statistically derived weighting factors for each model site. EPA summed the weighted loadings and removals across all sites in each subcategory to estimate subcategory-specific option loadings and removals for each option. EPA also summed the weighted loadings and removals across all sites to estimate industry-wide option loadings and removals.

Table 12-3 presents the estimated selected option pollutant loadings by subcategory for direct and indirect dischargers. Tables 12-4 and 12-5 present the estimated pollutant removals by the selected option in pounds (for direct dischargers only) and pound-equivalents (for both direct and indirect dischargers), respectively.

Note that, for the final rule, EPA did not provide option pollutant loadings or reductions for the Shipbuilding Dry Dock or Railroad Line Maintenance Subcategories. EPA concluded that pollutant removals associated with national regulation of these subcategories would be negligible. See DCNs 17859 and 17861 in Section 24.6.1 of the rulemaking record for more detailed discussion of the Shipbuilding Dry Dock and Railroad Line Maintenance Subcategories, respectively.

Table 12-1

POTW Removal Percentages For Each MP&M Pollutant of Concern

Chemical Name	POTW Percent Removal	Source
1,1,1-Trichloroethane	90.45	a
1,1-Dichloroethane	70	a
1,1-Dichloroethene	77.51	c
1,4-Dioxane	45.8	b
1-Bromo-2-Chlorobenzene	77.32	c
1-Bromo-3-Chlorobenzene	77.32	c
1-Methylfluorene	84.55	b
1-Methylphenanthrene	84.55	b
2,4-Dimethylphenol	77.51	c
2,4-Dinitrophenol	77.51	c
2,6-Dinitrotoluene	77.51	c
2-Butanone	96.6	b
2-Hexanone	77.32	c
2-Isopropylnaphthalene	77.32	c
2-Methylnaphthalene	28	b
2-Nitrophenol	26.83	a
2-Propanone	83.75	b
3,6-Dimethylphenanthrene	84.55	b
4-Chloro-3-Methylphenol	63	b
4-Methyl-2-Pentanone	87.87	b
4-Nitrophenol	77.51	c
Acenaphthene	98.29	a
Acetophenone	95.34	b
Acrolein	77.51	c
Alpha-Terpineol	94.4	b
Aluminum	91.36	a
Amenable Cyanide	57.41	c
Ammonia As Nitrogen	38.94	a
Aniline	93.41	b
Anthracene	77.51	c
Antimony	66.78	a
Arsenic	65.77	a
Barium	15.98	a
Benzoic Acid	80.5	b
Benzyl Alcohol	78	b

Table 12-1 (Continued)

Chemical Name	POTW Percent Removal	Source
Beryllium	71.66	c
Biphenyl	96.28	b
Bis(2-Ethylhexyl) Phthalate	59.78	a
BOD 5-Day (Carbonaceous)	89.12	a
Boron	30.42	a
Butyl Benzyl Phthalate	81.65	a
Cadmium	90.05	a
Calcium	8.54	a
Carbon Disulfide	84	b
Chemical Oxygen Demand (COD)	81.3	a
Chloride	57.41	c
Chlorobenzene	96.37	a
Chloroethane	77.51	c
Chloroform	73.44	a
Chromium	80.33	a
Cobalt	6.11	a
Copper	84.2	a
Cyanide	70.44	a
Di-N-Butyl Phthalate	84.66	a
Di-N-Octyl Phthalate	68.43	a
Dibenzofuran	77.32	c
Dibenzothiophene	84.68	b
Dimethyl Phthalate	77.51	c
Diphenyl Ether	77.32	c
Diphenylamine	77.32	c
Ethylbenzene	93.79	a
Fluoranthene	42.46	a
Fluorene	69.85	a
Fluoride	61.35	
Gold	32.52	c
Hexanoic Acid	84	b
Hexavalent Chromium	57.41	c
Iron	81.99	a
Isobutyl Alcohol	28	b
Isophorone	77.51	c
Lead	77.45	a
m+p Xylene	77.32	c

Table 12-1 (Continued)

Chemical Name	POTW Percent Removal	Source
m-Xylene	95.07	b
Magnesium	14.14	a
Manganese	35.51	a
Mercury	71.66	c
Methyl Methacrylate	99.96	b
Methylene Chloride	54.28	a
Molybdenum	18.93	a
n,n-Dimethylformamide	87	b
n-Decane	9	b
n-Docosane	88	b
n-Dodecane	95.05	b
n-Eicosane	92.4	b
n-Hexacosane	71.11	b
n-Hexadecane	71.11	b
n-Nitrosodimethylamine	77.51	c
n-Nitrosodiphenylamine	90.11	b
n-Nitrosopiperidine	77.32	c
n-Octacosane	71.11	b
n-Octadecane	71.11	b
n-Tetracosane	71.11	b
n-Tetradecane	71.11	b
n-Triacontane	77.32	c
Naphthalene	94.69	a
Nickel	51.44	a
o+p Xylene	65.4	b
o-Cresol	52.5	b
o-Xylene	77.32	c
Oil and Grease (as HEM)	86.08	a
p-Cresol	71.67	b
p-Cymene	99.79	b
Phenanthrene	94.89	a
Phenol	95.25	a
Phosphorus	32.52	c
Pyrene	83.9	b
Pyridine	95.4	b
Selenium	34.33	b
Silver	88.28	a

Table 12-1 (Continued)

Chemical Name	POTW Percent Removal	Source
Sodium	2.69	a
Styrene	93.65	b
Sulfate	84.61	b
Tetrachloroethene	84.61	a
Thallium	71.66	c
Tin	42	a
Titanium	91.82	a
Toluene	96.18	a
Total Dissolved Solids	8	b
Total Kjeldahl Nitrogen	57.41	c
Total Organic Carbon (TOC)	70.28	a
Total Petroleum Hydrocarbons (as SGT-HEM)	57.41	c
Total Phosphorus	57.41	c
Total Recoverable Phenolics	57.41	c
Total Sulfide	57.41	c
Total Suspended Solids	89.55	a
Trichloroethene	77.51	c
Trichlorofluoromethane	77.32	c
Tripropyleneglycol Methyl Ether	52.4	b
Vanadium	9.51	a
Weak-Acid Dissociable Cyanide	57.41	c
Yttrium	32.52	c
Zinc	79.14	a

Note: See the rulemaking record for further detail for the sources.
a - November 5, 1999 Updated 50-POTW Study. Influent Concentration 10xML, 5xML, then 20 ppb.
b - RREL Database. Compiled for the CWT effluent guideline or the 1995 Phase I Proposal.
c - Average POTW removals calculated by classification code from sources a and b.

Table 12-2

Summary of Baseline Annual Pollutant Loadings Discharged by Subcategory[a]

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)	
					Total[b]	TSS/Oil and Grease (as HEM)			Total[b]	TSS/Oil and Grease (as HEM)
General Metals	Direct	Option 2	1,521	2,009,351	174,459,398	7,322,917	228	270,336	13,555,899	1,297,831
	Indirect	Option 2, 1 MGY cutoff	2,354	6,234,209	1,106,541,984	41,557,113	NA			
		Upgrade Option	NA				429	391,340	369,856	NA
		50% Local Limits	NA				628	236,171	222,457,659	13,512,840
Metal Finishing Job Shops	Direct	Option 2	24	3,358	950,820	21,111	NA			
	Indirect	Option 2	1,270	438,866	63,845,074	2,002,275	NA			
		Upgrade Option	NA				314	82,633	146,194	NA
Non-Chromium Anodizing	Direct[c]	Option 2 (model site)	35	2,405,434	219,633,506	4,665,748	19	3,924	1,444,780	29,944
	Indirect	Not Proposed	NA							
Printed Wiring Board	Direct	Option 2	4	527	70,681	1,584	NA			
	Indirect	Option 2	840	923,431	82,596,963	4,040,990	NA			
		Upgrade Option	NA				354	73,624	130,639	NA
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M							
	Indirect	Option 2								
Oily Wastes	Direct	Option 6	2,749	11,149	30,585,116	5,709,823	2,382	3,351	6,454,146	588,817
	Indirect	Option 6, 2 MGY cutoff	288	78,247	189,374,738	46,336,329	NA			

Table 12-2 (Continued)

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)	
					Total[b]	TSS/Oil and Grease (as HEM)			Total[b]	TSS/Oil and Grease (as HEM)
Railroad Line Maintenance	Direct	Option 10	31	865	300,188	17,531	NA			
		Option 6	NA				9	NA		
	Indirect	Not Proposed	NA							
Shipbuilding Dry Dock	Direct	Direct	6	1,925	10,762,301	8,523,580	6	NA		
	Indirect	Not Proposed	NA							

Source: EPA Costs & Loadings Model.
[a]Baseline loads reflect the load after treatment, or raw loads if there is no treatment in place.
[b]Does not include sodium, calcium, total dissolved solids, and boron.
[c]EPA's data collection efforts did not identify any direct discharging non-chromium anodizing facilities.
NA - Not applicable.

Table 12-3

Summary of Selected Option Annual Pollutant Loadings Discharged by Subcategory[a]

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr) Total[b]	Pounds (lbs/yr) TSS/Oil and Grease (as HEM)	Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr) Total[b]	Pounds (lbs/yr) TSS/Oil and Grease (as HEM)
General Metals	Direct	Option 2	1,521	1,011,672	43,517,771	1,508,435	228	263,433	11,733,086	1,007,624
	Indirect	Option 2, 1 MGY cutoff	2,354	508,173	158,758,380	3,957,147	NA			
		Upgrade Option	NA				429	89,012	112,968	NA
		50% Local Limits	NA				628	99,666	89,456,128	820,566
Metal Finishing Job Shops	Direct	Option 2	24	1,707	292,154	5,618	NA			
	Indirect	Option 2	1,270	139,820	33,732,992	705,244	NA			
		Upgrade Option	NA				314	42,945	61,831	NA
Non-Chromium Anodizing	Direct[c]	Option 2 (model site)	35	12,698	6,263,130	449,851	19	1,879	1,193,263	19,297
	Indirect	Not Proposed	NA							
Printed Wiring Board	Direct	Option 2	4	341	45,733	1,055	NA			
	Indirect	Option 2	840	114,167	38,526,836	1,100,894	NA			
		Upgrade Option	NA				354	42,068	61,041	NA
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M							
	Indirect	Option 2								
Oily Wastes	Direct	Option 6	2,749	5,781	3,483,987	191,913	2,382	667	943,466	102,722
	Indirect	Option 6, 2 MGY cutoff	288	33,064	38,007,435	1,679,345	NA			

Table 12-3 (Continued)

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr)[b]	Pounds (lbs/yr)	
					Total[b]	TSS/Oil and Grease (as HEM)			Total[b]	TSS/Oil and Grease (as HEM)
Railroad Line Maintenance	Direct	Option 10	31	832	228,830	12,674	NA			
		Option 6	NA				9	NA		
	Indirect	Not Proposed	NA							
Shipbuilding Dry Dock	Direct	Direct	6	1,869	502,953	34,786	6	NA		
	Indirect	Not Proposed	NA							

Source: EPA Costs & Loadings Model.
[a]Option loads reflect the load after the implementation of the MP&M technology basis for each subcategory.
[b]Does not include sodium, calcium, total dissolved solids, and boron.
[c]EPA's data collection efforts did not identify any direct discharging non-chromium anodizing facilities.
NA - Not applicable.

Table 12-4

Industry Pollutant Removals in Pounds (for Direct Dischargers)

Subcategory	Options Evaluated Since Proposal	NODA Removals (lbs)			Final Rule Removals (lbs)			Option Promulgated?
		Total	TSS/Oil and Grease (as HEM)	Priority and Nonconventional Metals/Organics	Total	TSS/Oil and Grease (as HEM)	Priority and Nonconventional Metals/Organics	
General Metals	Option 2	130,941,626	5,814,481	5,693,724	1,822,813	290,207	56,320	No
Metal Finishing Job Shops	Option 2	658,666	15,492	35,661	NA			No
Non-Chromium Anodizing	Option 2 (model site)	213,370,375	4,215,897	37,401,639	251,517	10,646	16,159	No
Printed Wiring Board	Option 2	24,949	530	1,078	NA			No
Steel Forming and Finishing	Option 2	Not Covered by MP&M						No
Oily Wastes	Option 6	27,101,129	5,517,909	108,748	5,510,680	486,094	11,271	Yes
Railroad Line Maintenance	Option 10	71,358	4,857	482	NA			No
	Option 6	NA			NA			No
Shipbuilding Dry Dock	Option 10	10,259,349	8,488,793	1,796	NA			No

Source: EPA Costs & Loadings Model.
Note: Loadings estimates presented in this table will not equal those presented in the EEBA. EEBA estimates do not include loadings for facilities that are projected to close in the baseline.
NA- Not applicable.

Table 12-5

Industry Pollutant Removals in Pound-Equivalents

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA		Final Rule		Option Promulgated?
			Number of Sites	Pollutant Removals (PE)	Number of Sites	Pollutant Removals (PE)	
General Metals	Direct	Option 2	1,521	997,678	228	6,903	No
	Indirect	Option 2, 1 MGY cutoff	2,354	1,360,332	NA		No
		Upgrade Option	NA		429	39,734	No
		50% Local Limits	NA		628	39,630	No
Metal Finishing Job Shops	Direct	Option 2	24	1,652	NA		No
	Indirect	Option 2	1,270	95,149	NA		No
		Upgrade Option	NA		314	6,034	No
Non-Chromium Anodizing	Direct	Option 2 (model site)	35	2,392,735	19	2,045	No
	Indirect	Not Proposed	NA				No
Printed Wiring Board	Direct	Option 2	4	186	NA		No
	Indirect	Option 2	840	153,653	NA		No
		Upgrade Option	NA		354	5,157	No
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M				No
	Indirect	Option 2	Not Covered by MP&M				No
Oily Wastes	Direct	Option 6	2,749	5,367	2,382	2,684	Yes
	Indirect	Option 6, 2 MGY cutoff	288	14,385	NA		No
Railroad Line Maintenance	Direct	Option 10	31	34	NA		No
		Option 6	NA		9	NA	No
	Indirect	Not Proposed	NA				No
Shipbuilding Dry Dock	Direct	Option 10	6	56	6	NA	No
	Indirect	Not Proposed	NA				No

Source: EPA Costs & Loadings Model.
Note: Loadings estimates presented in this table will not equal those presented in the EEBA. EEBA estimates do not include loadings for facilities that are projected to close in the baseline.
NA - Not applicable.